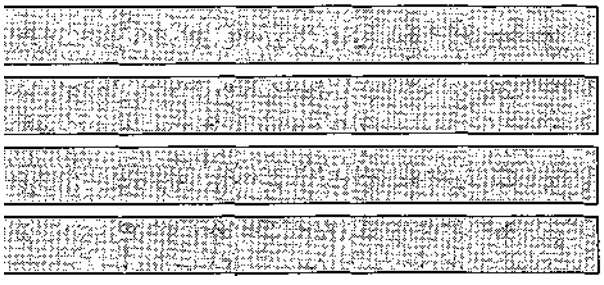
Contract Report 634

Ground-Water Investigation in the Embarras River Valley, Jasper County, Illinois

by
Ellis W. Sanderson, RE.
Office of Ground-Water Resources Evaluation

Prepared for the
E J Water Corporation

July 1998



Illinois State Water Survey
Hydrology Division
Champaign, Illinois

A Division of the Illinois Department of Natural Resources

GROUND-WATER INVESIGATION IN THE EMBARRAS RIVER VALLEY, JASPER COUNTY, ILLINOIS

by

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ISSN 0733-3927

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GROUND-WATER INVESTIGATION IN THE EMBARRAS RIVER VALLEY JASPER COUNTY, ILLINOIS FOR THE E J WATER CORPORATION

by
Ellis W. Sanderson, P.E., Senior Engineer

INTRODUCTION

The E **J** Water Corporation, a not-for-profit corporation, operates a water utility to serve town and rural residents in Effingham and Jasper Counties. The corporation developed a well-field supply in the Embarras River valley in 1992 and began operation in fall 1993. Rapid pumpage growth during the early months of operation and the excellent prospects for expansion of the service area resulted in the yield capacity of the well field being questioned.

A 1994 review of available information for the E J Water well field developed in 1992-1993, and the operational history for the well field operated by the city of Newton, about 9 miles downstream, suggested that the long-term sustained yield of the E J Water well field might be in the range of 400,000 to 500,000 gallons per day (gpd). Since the 1994 review, the corporation has sought to expand its existing ground-water supply to meet the increased water demands caused by expansions of the water system to selected areas beyond Effingham and Jasper Counties. Illinois State Water Survey (ISWS) staff recommended the development of a second well field in the Embarras River valley at least 2 to 3 miles from the first well field (see appendices A-L for reports, analyses, and other supporting data).

Subsequently, in an area in Section 10, T.7 N., R.9 E., Jasper County, the corporation arranged for an electrical earth resistivity survey to be conducted by the Illinois State Geological Survey (ISGS), contracted for several episodes of test borings to confirm the presence and texture of a sand-and-gravel aquifer, and contracted with the ISWS to conduct aquifer tests to evaluate the yield potential of the aquifer to a new well field.

ACKNOWLEDGMENTS

I thank Mr. Delbert Mundt, President, E J Water Corporation, and the corporation's Board of Trustees for the opportunity to cooperatively conduct aquifer tests, and I appreciate the opportunity to work with consulting engineer, Mr. Pat Milano, Milano and Grunloh, Inc., as well as Mr. David Klitzing, Manager, and Mr. Dan Mahaffey, Operator, for the water utility. Planned aquifer tests proceeded in an efficient manner because of the professional approach by Mr. Mundt and Mr. Klitzing, supported by the E J Water Corporation Board of Trustees, and the capability of the drilling contractor, Speth Plumbing, Inc.

Special thanks to Robert D. Olson, Associate Hydrologist, for his assistance with the field work during the step tests and the aquifer tests. Adrian P. Visocky, Senior Hydrologist and

Director, Office of Ground-Water Resources Evaluation, reviewed the aquifer test analyses and the report manuscript. Water samples collected by ISWS staff during the tests were analyzed by the Analytical and Water Treatment Services Laboratory under the supervision of Loretta Skowron.

I also acknowledge the assistance of Pamela Lovett (word processing of the reproducible copy of this report), Agnes Dillon (editing of the manuscript), and Linda Hascall (preparation of the graphics).

The views expressed in this report are those of the author and do not necessarily reflect the views of the sponsor.

SUMMARY OF WELL FIELD ONE (NORTH) DEVELOPMENT

The present valley of the Embarras River is generally underlain by deposits of sand and gravel that offer potential for the development of ground-water supplies. The sand-and-gravel deposits are often about 20 to 40 feet thick and offer the opportunity to develop individual wells with moderate pumping rates of 100-300 gallons per minute (gpm). The E J Water Corporation first developed a well field (north) in 1992-1993 in the Embarras River bottomlands in Section 34, T.8 N., R.9 E., Jasper County, Illinois (see figure 1).

The initial development of the first well field (north) included the conduct of a 48-hour aquifer test December 3-5, 1991, in cooperation with the ISWS using the first production well and three observation wells to evaluate the safe yield. However, electronic equipment failure during the conduct of the test resulted in loss of most of the water level data for two of the observation wells and the production well. The aquifer test was not repeated.

This loss of data caused the resulting analysis for safe yield to be seriously compromised. The history of development and the use of the same aquifer system since the mid-1960s by the city of Newton provided reference for the analysis of the limited data available. The analysis of the available data suggested the production well (Well 1) could yield about 300 gpm (432,000 gpd) on a long-term basis if the condition of the well did not deteriorate. The possible yield of a well field was not determined, but a second production well (Well 2) was drilled in 1992 for standby use. The water corporation commenced use of this well field in 1993 without having a firm estimate of the safe yield of the well field.

Production Well 3 was added in 1994 as expansion of the area served by the corporation continued. The increasing water demand made the issue of safe yield of the first (north) well field vital. A new controlled aquifer test was not possible because of water system demands and the regular use of the production wells. The average daily pumpage approached 300,000 gpd by 1994, or about 70 percent of the estimated safe yield of the first production well.

In the absence of a firm safe yield estimate for the well field, an aquifer monitoring program was recommended by the ISWS in January 1995 (see letter dated January 17, 1995, in

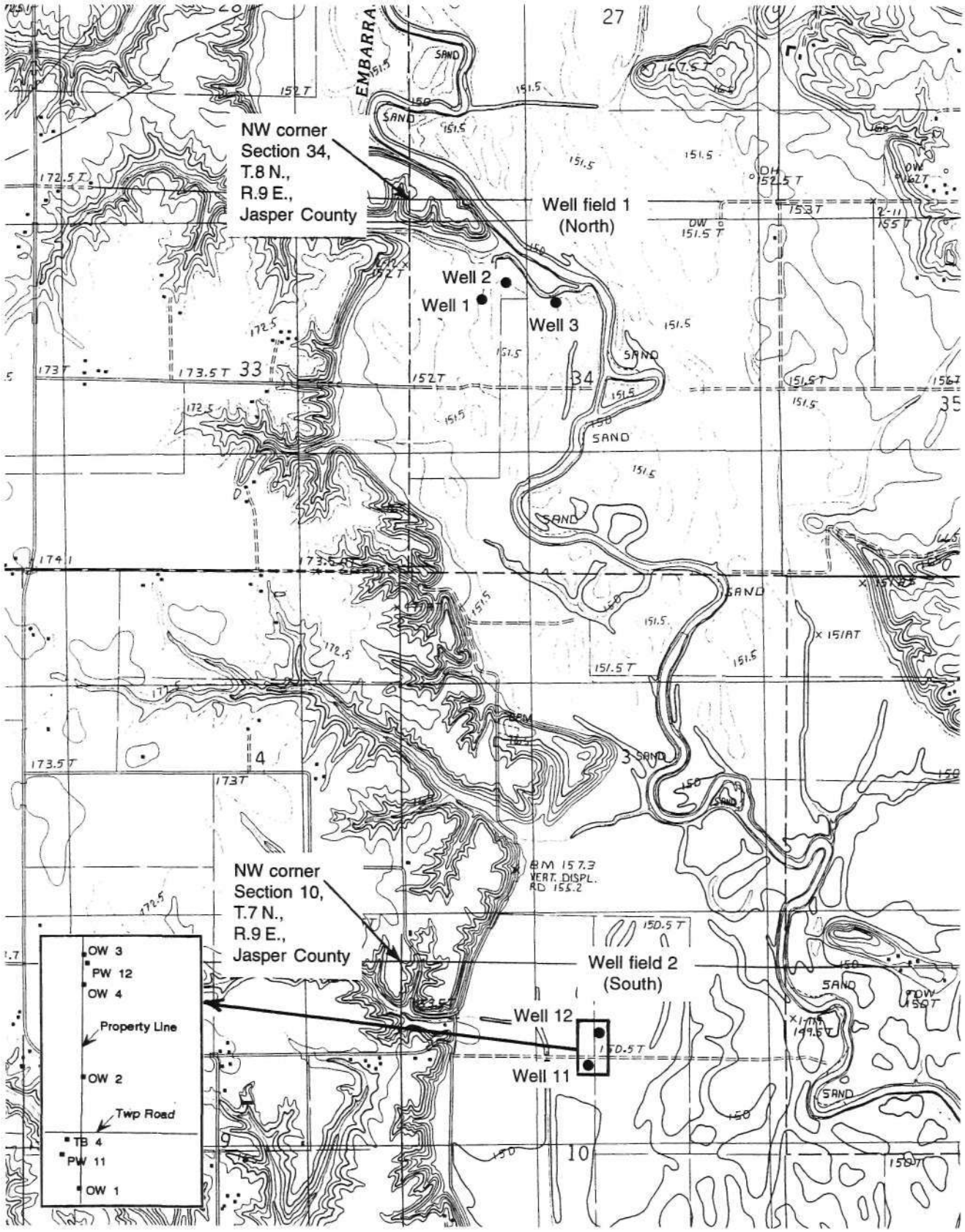

Figure 1. Location of E J Water Corporation well field sites

appendix L). This monitoring program commenced later in 1995 when two permanent observation wells were installed in the well field to monitor ground-water levels in the sand-and-gravel aquifer. (Geophysical logging of these wells was later done by the ISGS. That information is given in a report dated April 30, 1996, included in appendix A.) Treated water is metered at the water treatment plant. At present, ground-water levels are being measured in the three production wells and the two observations wells once every 10 days. The lack of ground-water level decline through 1996 suggests that 1996 pumpage from the well field is within the safe yield capability of the sand-and-gravel aquifer, but this does not yet provide insight about the safe yield of the well field during drought (see figures 2 and 3). Plans are to continue this monitoring program and to review the pumpage and water level data at least annually. This monitoring program will measure the response of the aquifer to pumpage and will, over time, provide the basis for making an assessment of safe yield of this well field.

PRELIMINARY INVESTIGATIONS AT WELL FIELD TWO (SOUTH)

The corporation first arranged with the ISGS to conduct a reconnaissance electrical earth resistivity survey (EERS) in an area of the Embarras River bottomlands about 2 miles south of the original well field. An EERS is often used to prospect for the presence of water-yielding sand-and-gravel deposits in the unconsolidated materials above bedrock. The EERS was conducted in October 1994 and offered suggested locations for test drilling in Section 10, T.7 N., R.9 E., Jasper County (see report of EERS dated December 2, 1994, in appendix A).

In June 1995 the corporation contracted with Speth Plumbing, Inc., for test drilling to determine sand-and-gravel aquifer thickness and texture in the area recommended by the resistivity survey. Six test borings (TB) showed water-bearing sand-and-gravel deposits to be generally present in the area of interest (see appendix A). One test boring, TB 4, was cased with 2-inch galvanized pipe with a sand point well screen at the bottom. Geophysical logs of TB 4 were made by the ISGS (see appendix A). To help confirm whether the sand-and-gravel aquifer present in the area in the vicinity of TB 4 had potential for development of the second well field, additional TBs were made in November 1995 and May 1996 (see appendix A).

A controlled aquifer test was planned for the second (south) well field site to estimate the long-term safe yield of a well field. The E J Water Corporation contracted with Speth Plumbing, Inc., to drill a production well and observation wells for an aquifer test, and with the ISWS to conduct and evaluate the aquifer test. Production Well 11 and three observation wells were drilled for the aquifer test. The aquifer test investigation was conducted cooperatively by the E J Water Corporation, the ISWS, Milano and Grunloh, Inc., and Speth Plumbing, Inc.

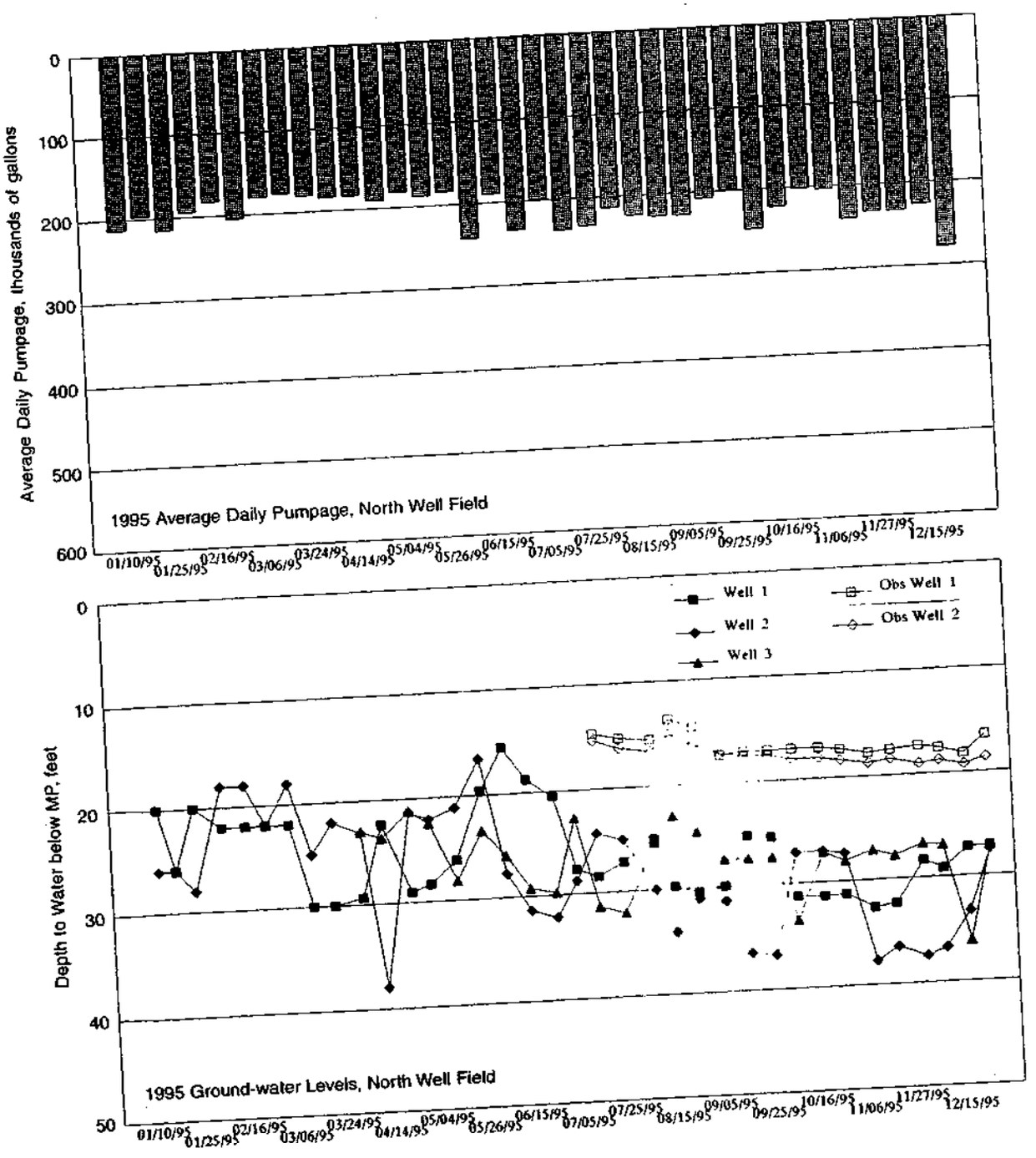

Figure 2. Pumpage and ground-water levels, North Well Field, 1995

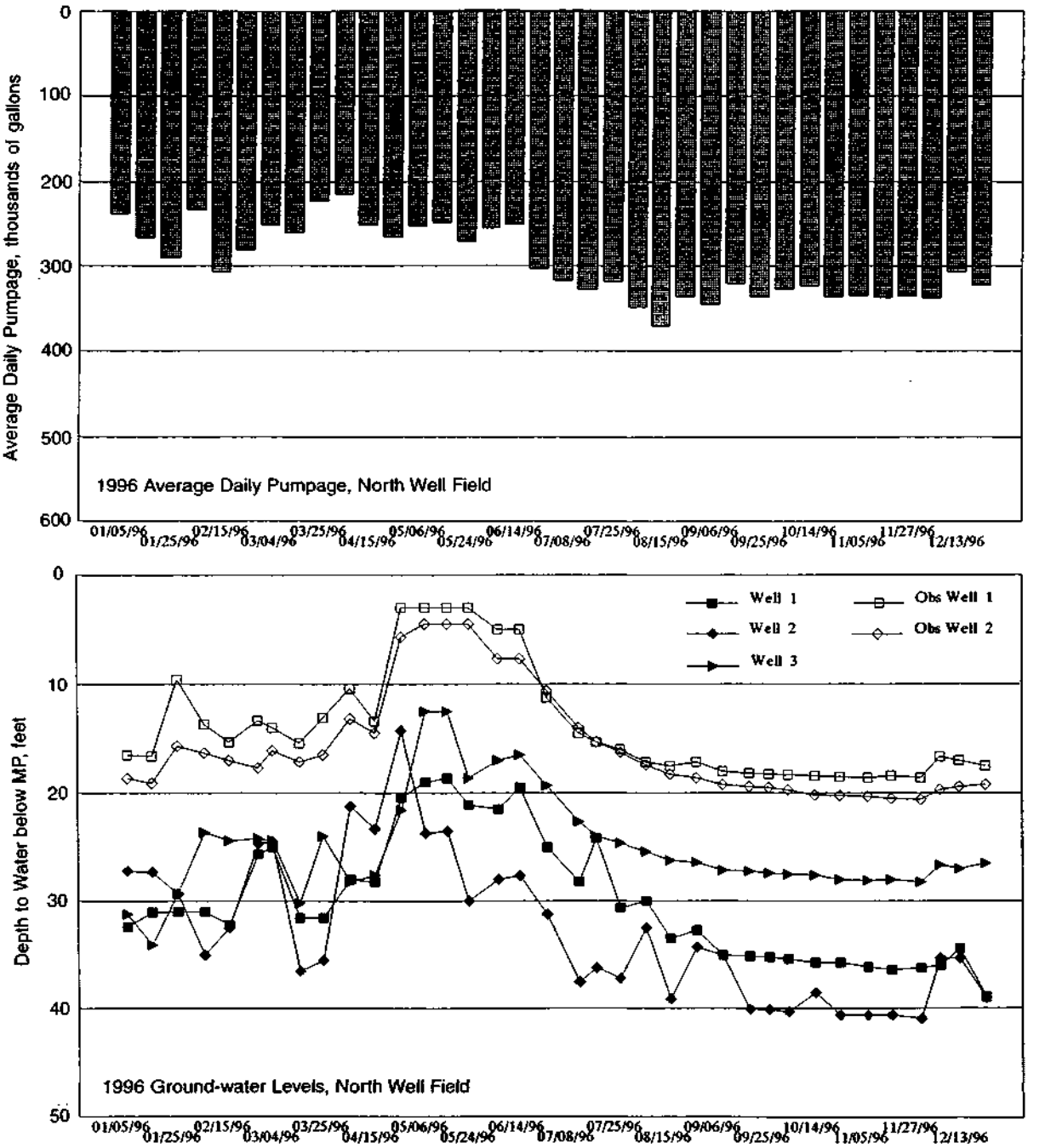

Figure 3. Pumpage and ground-water levels, North Well Field, 1996

INVESTIGATIVE METHODS AND PROCEDURES

Testing Program

Objective

The principal objective of this investigation was to estimate the potential for ground-water resource development in the vicinity of TB 4 located in the NE¼, SE¼, NW¼, Section 10, T.7 N., R.9 E. Jasper County. A water supply of at least 200 gpm (288,000 gpd) was desired to meet the capacity of an expanded water treatment plant. An aquifer test was designed to evaluate the yield of the sand-and-gravel aquifer to a well or well field.

Description of Site

The proposed well-field site (see figure 1) is on two parcels of land in the north-central part of Section 10 about 3 miles west of the community of Falmouth and about 6 miles east of the village of Wheeler. The site is located in broad, flat agricultural land subject to flooding by the Embarras River. Surface water runoff is via a drainage ditch about 1,400 feet west of the site and south to Mint Creek and the Embarras River.

Production Well 11 was drilled near TB 4, and three observation wells were drilled north and south of Well 11. These observation wells confirmed the presence of the sand-and-gravel aquifer found in nearby TB 4. The aquifer generally was about 30 to 40 feet thick, overlain by about 10 to 15 feet of clay and top soil (see appendix B). Subsequent to the aquifer test with Well 11, a second production well, Well 12, was drilled in the well field, and a second aquifer test was conducted.

Design of Tests

The available information from the test drilling suggested that the sand-and-gravel aquifer was reasonably extensive in the river bottomland area and offered good-to-excellent opportunity for the desired supply.

To achieve the objective of evaluating the potential yield of this river bottomland sand-and-gravel aquifer to a well or well field, the study focused on conducting an aquifer test for a period of seven days. The aquifer test would consist of pumping the test well at a constant, uninterrupted rate for the test period while observing ground-water levels in the pumping test well and three observation wells.

Prior to the aquifer test, a step test was planned for the pumping test well to help determine an appropriate pumping rate for the seven-day aquifer test and to estimate the hydraulic efficiency of the test well. The response of the well and aquifer during the step test would help determine a pumping rate that could be sustained for the desired seven-day constant-rate aquifer test, and stress the aquifer system enough to provide meaningful data for analysis. For this investigation, the primary purpose of the step test was to collect data to determine the

well-loss coefficient of the well to enable calculation of the portion of observed drawdown attributable to well inefficiencies. Well loss, described in more detail later, is an additional component of observed drawdown in pumping wells that can significantly reduce sustainable yields. The step test was to consist of pumping the test well at increasing increments of the full rate for about 30 minutes at each rate. During the test, ground-water levels would be observed in the pumping test well and, as convenient, in one or more observation wells.

Evaluation Methodology for Step Tests

Well Loss

Water is removed from storage within the aquifer when a well is pumped. This causes water levels to decline over time in the vicinity of the well. This effect, referred to as drawdown, is most pronounced at the pumped well and gradually diminishes at increasing distances away from the well. Drawdown is the distance the water level declines from its nonpumping stage and, under ideal conditions, is a function of pumping rate, time, and the aquifer's hydraulic properties. Aquifer boundaries, spatial variation in aquifer thickness or hydraulic properties, interference from nearby wells, and partial-penetration conditions all can affect observed drawdowns at both pumping and observation wells. However, well loss or the additional drawdown inside the pumped well due to turbulent flow of water into and inside the well is a measure of the hydraulic efficiency of the pumping well only; it reflects the unique flow geometry of the borehole, well screen, and pump placement.

Because of well loss, the observed drawdown in a pumped well is usually greater than that in the aquifer formation outside the borehole. In addition to considerations of flow geometry, the amount of well loss also can depend on the materials used (screen openings, gravel-pack size distribution, drilling fluids, etc.) and the care taken in constructing and developing the well using mechanical and hydraulic means to remove drilling fluids from the borehole. Some well loss is natural because of the physical blocking of the aquifer interstices caused by the well screen and the disturbance of aquifer material around the borehole during construction. However, an improperly designed well and/or ineffective well construction and development techniques can result in unacceptable well losses. In addition, well losses often reflect a deterioration in the condition of an existing well, especially if they are observed to increase over time.

Well loss is a function of pumping rate, but ideally not of time. It is associated with changes in flow velocity in the immediate vicinity of the well, resistance to flow through the well screen, and changes in flow path and velocity inside the well, all of which cause the flow to change from laminar to turbulent in form. Head losses under turbulent conditions are nonlinear; that is, drawdowns increase more rapidly with increases in pumping rate than under laminar conditions.

Although it is possible to have turbulent flow within the aquifer and laminar flow within a pumping well, under usual conditions the observed drawdown (s_w) in a pumping well is made up of two components: the formation loss (s_a), resulting from laminar flow head loss within the

aquifer; and well loss (s_w), resulting from the turbulent flow of water into and inside the well, as shown in equation 1.

$$s_o = s_a + s_w \quad (1)$$

Assuming that all formation losses are laminar and all well losses are turbulent, Jacob (1947) devised a technique for separating the well losses from the formation losses. These components of theoretical drawdown, s, in the pumped well are expressed as being proportional to pumping rate, Q, in the following manner:

$$s = BQ + CQ^2 \quad (2)$$

where B is the formation-loss coefficient at the well-aquifer interface per unit discharge, and C is the well-loss coefficient. For convenience, s is expressed in feet and Q in cubic feet per second (ft^3/sec). Thus, the well-loss coefficient C has the units sec^2/ft^5

Rorabaugh (1953) suggested that the well-loss component be expressed as CQ^n, where n is a constant greater than 1. He thus expressed the drawdown as:

$$s = BQ + CQ^n \quad (3)$$

To evaluate the well-loss component of the total drawdown, the well-loss coefficient (if using equation 2) or both the coefficient and the exponent (if using equation 3) must be known. This analysis requires a controlled pumping test, called a step-drawdown test, in which total drawdown is systematically measured and pumping rates are varied in a stepwise manner.

Methodology for Determining Well Loss

If Jacob's equation (equation 2) is used to express drawdown, then the coefficients B and C must be determined. A graphical procedure (Bierschenk, 1964) can be used after first modifying equation 2 as:

$$s/Q = B + CQ \quad (4)$$

After this modification, a plot of s_o/Q versus Q can be prepared on arithmetic graph paper from data collected during a step drawdown test, with the observed drawdown, s_o, substituted for s. The slope of a line fitted to these data is equal to C, and the y-intercept is equal to B, as shown in figure 4. If the data do not fall along a straight line but curve concavely upward, the curvature of the plotted data indicates that the second-order relationship between Q and s_o is not valid, and the Rorabaugh (1953) method of analysis usually is appropriate.

Occasionally the data plot of s_o/Q versus Q may yield a straight-line fit with essentially a zero or a negative slope, or the data may be too scattered to allow a reasonable fit to be made at all. In these instances, the well-loss parameters are immeasurable. Possible explanations for this are: 1) turbulent well loss was negligible for the range of pumping rates used during the test;

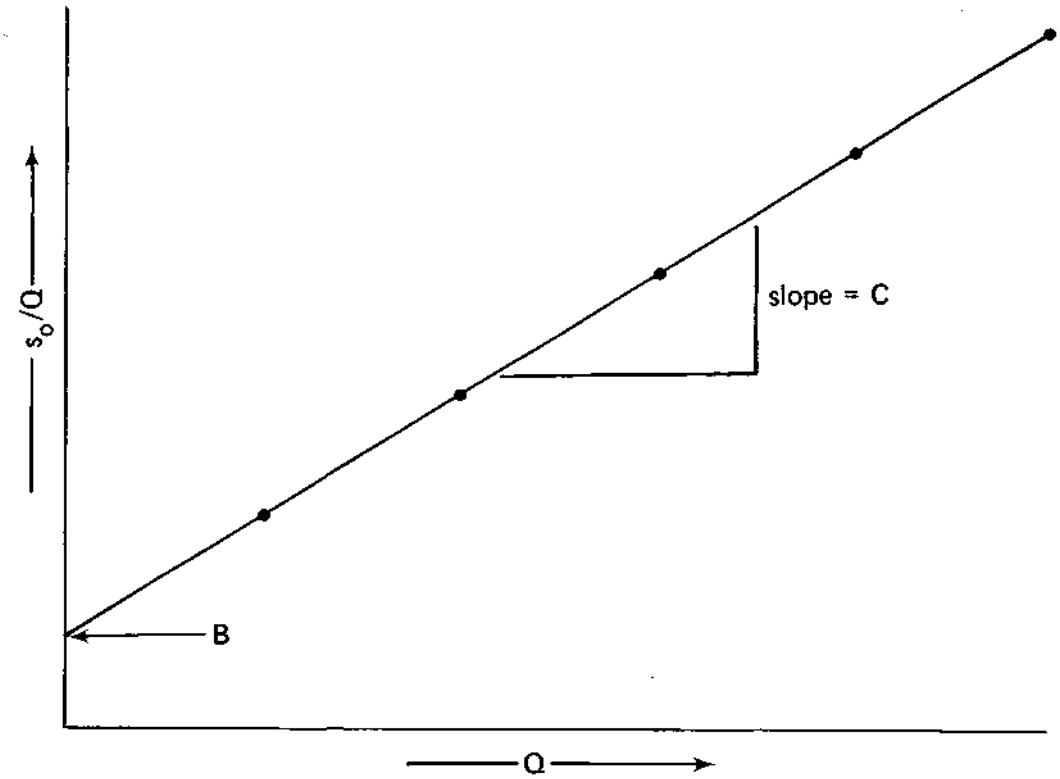

Figure 4. Graphical solution of Jacob's equation for well-loss coefficient, C

2) inadequate data collection or test methods were used during the test; 3) the hydraulic condition of the well was unstable, as is the case during well development; or 4) the contribution of water from the aquifer was not uniform along the entire length of the well screen over the range of pumping rates, due to the pump setting in relation to the screen or to vertical heterogeneity of the aquifer materials.

Step-Test Procedure

The primary objective of a step-drawdown test (or step test) is the determination of the well-loss coefficient (and exponent, if using Rorabaugh's method (equation 3)). With this information, the turbulent well-loss portion of drawdown for any pumping rate of interest can be estimated. During the test, the discharge rate is successively increased or decreased over the previous rate, in approximately equal increments, to facilitate the data analysis. Each pumping period at a given rate is called a step, and all steps are of equal duration. Generally, the pumping rates increase from step to step, but the test also can be conducted by decreasing the pumping rates. During each step, the pumping rate is held constant. If data are collected manually, water-level measurements are made every minute for the first six minutes, every two minutes for the next ten minutes, and then every four to five minutes thereafter until the end of the step. For the step tests in this study, an InSitu Hermit datalogger, programmed to collect data once each minute during the step test, was used.

Schematically, the relationship between time and water level resembles that shown for a five-step test in figure 5. Incremental drawdowns for each step (shown as Δs_j) are measured as the distance between the extrapolated water levels from the previous step and the final water level of the current step. For step 1, the nonpumping water-level trend prior to the start of the test is extrapolated, and Δs, is measured from this datum. All data extrapolations should be performed on semilog graph paper for the most accurate results. For the purpose of plotting s_o/Q versus Q, values of observed drawdown s_o are equal to the sum of Δs_j for a given step. Thus, for step 3, $s_o = \Delta s, + \Delta s_2 + \Delta s_3$.

Evaluation Methodology for Aquifer Tests

Analysis

The capacity of a formation to transmit ground water is expressed by the *transmissivity,* which is the rate of flow of water, in gallons per day, through a one-foot-wide vertical strip of the aquifer extending the full saturated thickness under a hydraulic gradient of 100 percent (1 foot per foot) at the prevailing water temperature. Transmissivity is the product of the saturated thickness of the aquifer and the *hydraulic conductivity,* which is the rate of flow of water, in gallons per day, through a cross-sectional area of 1 square foot of the aquifer under a hydraulic gradient of 100 percent at the prevailing water temperature.

The storage properties of an aquifer are expressed by the *storage coefficient,* the volume of water released from storage per unit surface area of the aquifer per unit change in the water level. This parameter is dimensionless.

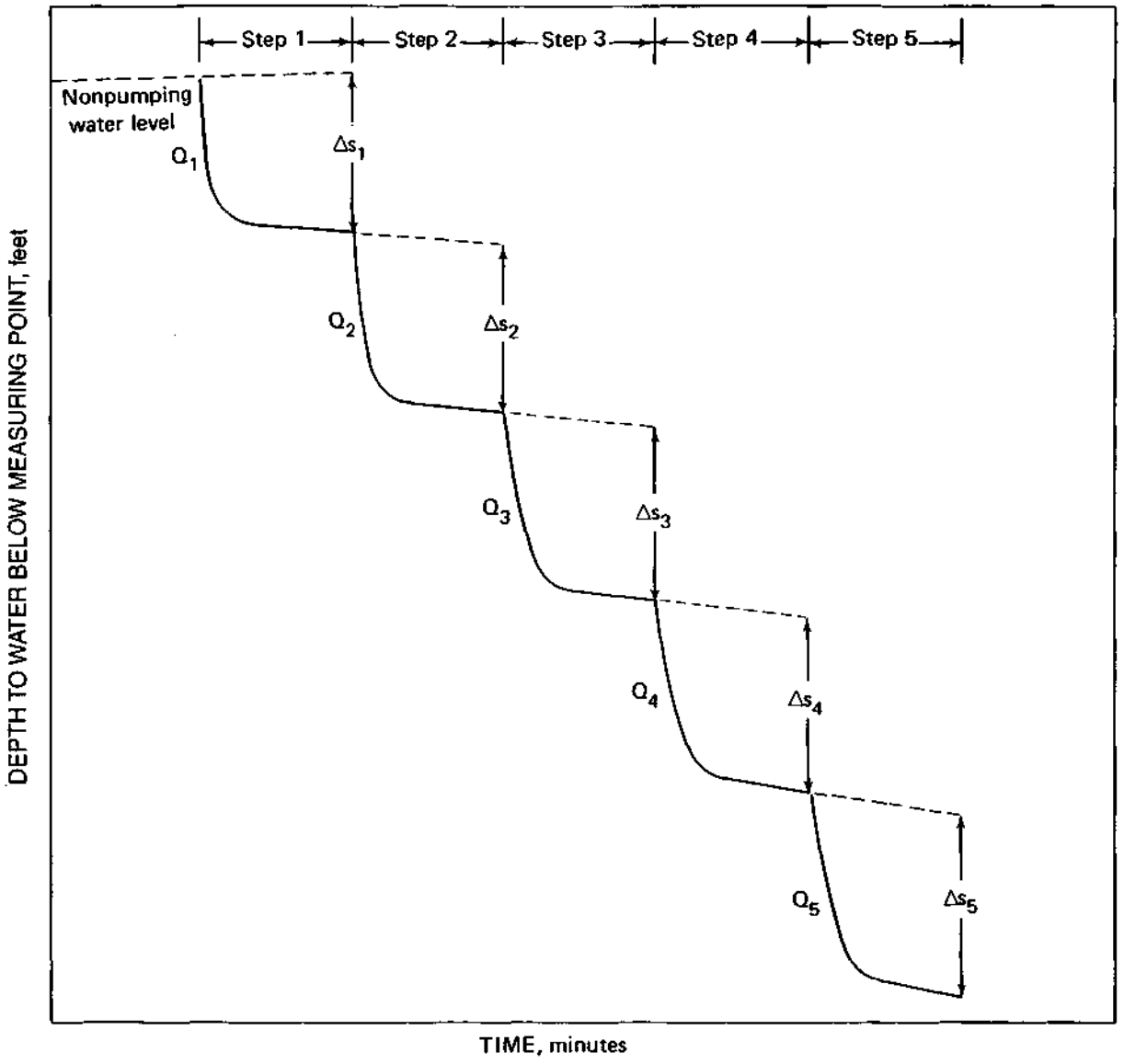

Figure 5. Relationship between time and water-level during a five-step drawdown test

The hydraulic properties of an aquifer may be determined by means of an aquifer test, in which the effect of pumping a well at a known constant rate is measured in the pumped well and at observation wells that penetrate the aquifer at various distances from the pumped well. Graphs of drawdown (the lowering of water levels in the wells) versus time after pumping starts and/or drawdown versus distance from the pumped well are used to solve equations that express the relation between the transmissivity, storage coefficient, pumping rate, and drawdown. When appropriate, drawdown data must be adjusted to account for conditions that affect the observed rate of drawdown, such as variations in pumping rate, barometric pressure fluctuations, pumping in nearby wells, aquifer boundaries, leakage, significant dewatering (see later discussion of water-table conditions), or a partially penetrating pumped well. The two most common methods of analysis for field data under nonleaky artesian conditions—the type-curve method (Theis, 1935) and the Jacob (Cooper and Jacob, 1946) straight-line method—will be described.

Type-Curve Method

Theis (1935) introduced an analogy between the nonsteady flow of ground water and heat conduction. The nonequilibrium formula—popularly known as the Theis equation—describes radial flow toward a well pumping from an artesian aquifer as:

$$s = \frac{Q}{4\pi T} W(u) \tag{5}$$

or in commonly used units,

$$s = \frac{114.6Q}{T} W(u) \tag{6}$$

where:

$$W(u) = \int_u^\infty \frac{e^{-u}}{u} du = -0.5772 + \ln u + u - \frac{u^2}{2 \cdot 2!} + \frac{u^3}{3 \cdot 3!} - \frac{u^4}{4 \cdot 4!} + \cdots \tag{7}$$

and

$$u = \frac{2693 r^2 S}{Tt} \tag{8}$$

where:

s = drawdown at distance r from the pumped well, in feet
Q = well discharge, in gpm
T = transmissivity, in gpd/ft
r = distance from pumped well to observation point, in feet
S = storage coefficient, decimal fraction
t = time since pumping began, in minutes

W(u), referred to as the *well function for nonleaky artesian aquifers,* has been extensively tabulated.

Theis (1935) devised a graphical procedure using superposition to solve for the aquifer properties, T and S, using equations 6 and 8, but inverting equation 8:

$$s = \frac{114.6Q}{T} W(u) \tag{9}$$

and

$$\frac{1}{u} = \frac{Tt}{2693r^2S} \tag{10}$$

Expanding the logarithm of both sides of these equations yields:

$$\log s = \log \left[\frac{114.6Q}{T}\right] + \log W(u) \tag{11}$$

and

$$\log \frac{1}{u} = \log \left[\frac{T}{2693r^2S}\right] + \log t \tag{12}$$

In equation 11 the term log [114.6Q/T] is a constant for a given pumping rate (hence, the need for a constant pumping rate during tests), so log s is directly related to log W(u). In equation 12 the term log $[T/2693r^2 S]$ is a constant for a given distance r (a selected observation well), so log 1/u is directly related to log t. Thus,

$$\log s \propto \log W(u)$$

and

$$\log t \propto \log 1/u$$

From these relationships, one can construct a plot of the well function W(u) versus 1/u on log-log graph paper (figure 6). Such a plot of a mathematical function is called a *type curve.* Likewise, one can plot on identical log-log paper a plot of drawdown s versus time t from the data collected at each observation well.

The type curve is then superimposed over the field-data plot, keeping the corresponding ordinate and abscissa axes parallel, until a best fit is obtained. A convenient match point is chosen on the two graphs (usually one that includes the convenient type-curve match point of W(u) = 1 and 1/u = 10). The corresponding coordinates of W(u), 1/u, s, and t then are substituted into equations 6 and 8 to solve for T and S.

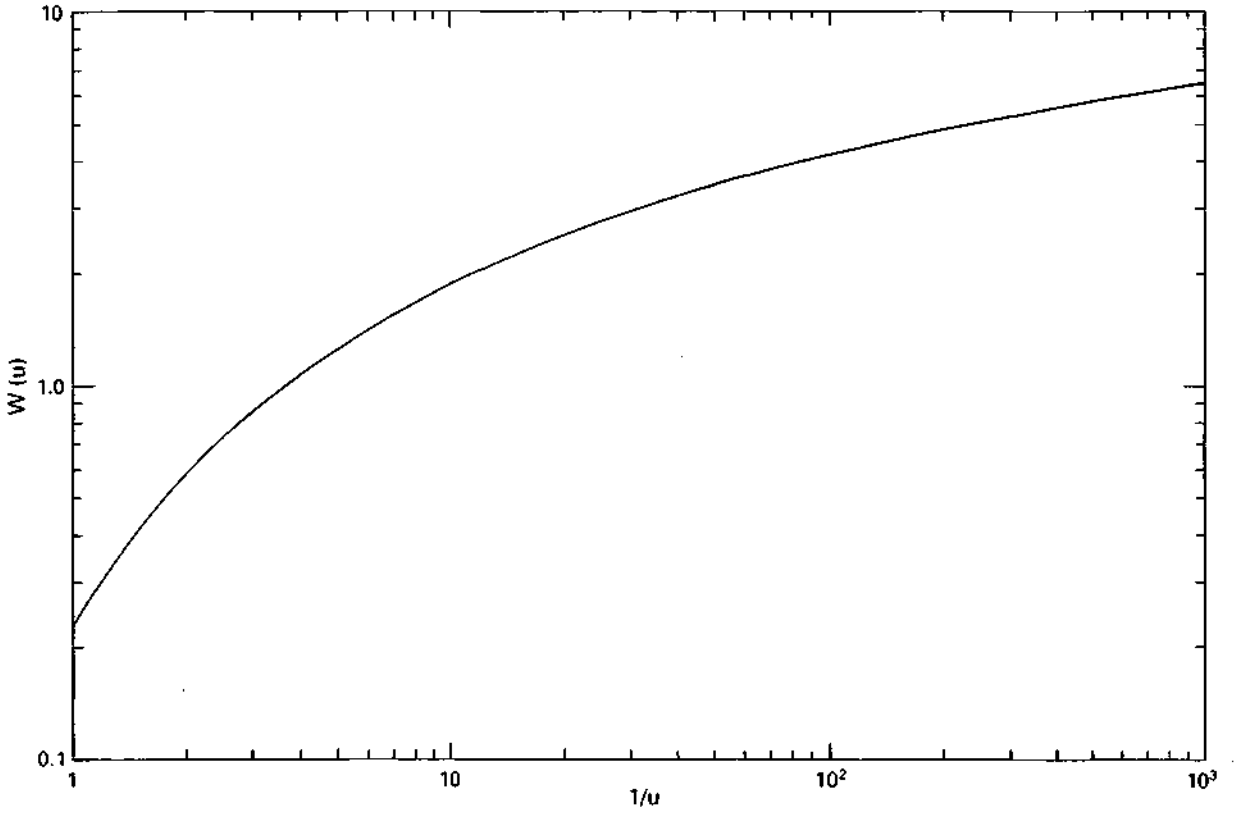

Figure 6. Nonleaky artesian type curve

In the same manner, one could make a type curve of W(u) versus u, noting the relationship between s versus W(u) and between u and r^2. For an aquifer test in which several observation wells were used, one could fit the new type curve to a field-data plot of s versus r^2 for a given time, and follow the same procedure of fitting the type curve to the field-data plot and selecting a match point.

Jacob Straight-Line Method

A popular graphical method derived from the Theis method by Cooper and Jacob (1946) is referred to as the *modified nonleaky artesian formula*, or simply the *Jacob straight-line method.* The method is based on the fact that, when values of u are small (less than 0.01), the sum of the series terms in equation 7 beyond In u becomes insignificant. An examination of the terms in equation 8 shows that u becomes small when r becomes small (close-in observation wells) or t becomes large (long pumping periods).

When $u \leq 0.01$, field-data plots of drawdown versus log time on semilog paper will yield a straight line. The straight-line portion of the s versus t plot is extrapolated to its intersection with the zero-drawdown axis. The slope of the straight line (drawdown per log cycle) is used to solve for the transmissivity, and the zero-drawdown intercept is used to solve for the storage coefficient. Expressions for these computations, derived by Cooper and Jacob (1946), are:

$$T = \frac{264Q}{\Delta s} \tag{13}$$

and

$$S = \frac{Tt_0}{4790r^2} \tag{14}$$

where:

T = transmissivity, in gpd/ft
Q = well discharge, in gpm
ΔS = drawdown difference per log cycle, in feet
S = storage coefficient, decimal fraction
t_o = intersection of straight-line slope with zero-drawdown axis, in minutes
r = distance from pumped well to observation point, in feet

The Jacob straight-line method also can be extended to plots of drawdown versus distance for given time values. Field-data plots of drawdown versus log distance on semilog paper will yield a straight line in the region where $u \leq 0.01$. The straight-line portion of the graph is extrapolated to its intersection with the zero-drawdown axis. The slope of the straight line is used to solve for T, and the zero-drawdown intercept is used to solve for S, using the following expressions:

$$T = \frac{528Q}{\Delta s} \quad (15)$$

and

$$S = \frac{Tt}{4790r_0^2} \quad (16)$$

where:

r_0 = intersection of straight-line slope with zero-drawdown axis, in feet, and all other terms are as defined above.

The Jacob (Cooper and Jacob, 1946) straight-line method is popular because of its simplicity; however, its use is restricted to field data that satisfy the "u-criterion" of $u < 0.01$. Deviation from a straight line becomes appreciable when u exceeds 0.02 (Walton, 1962). The Jacob straight-line method should be used to supplement, rather than supersede, the type-curve method.

Water-Table Conditions

The methods described in the previous section pertain to artesian aquifer conditions; however, the formulas also can be applied to the results of aquifer tests made under water-table (unconfined) conditions. These formulas were developed in part based on the assumptions that the coefficient of storage is constant and water is released from storage instantaneously with a decline in water levels. Under water-table conditions, water is derived largely from storage by the gravity drainage of the interstices in the portion of the aquifer dewatered by the pumping. The gravity drainage of water through stratified sediments is not immediate, and the nonsteady flow of water toward a well in an unconfined aquifer is characterized by slow drainage in interstices.

Gravity drainage of interstices decreases the saturated thickness and, therefore, the transmissivity of the aquifer. Under water-table conditions, it is necessary to compensate for observed values of drawdown by the decrease in saturated thickness before the data can be used to determine the hydraulic properties of the aquifer. The following equation derived by Jacob (1944) is used to adjust drawdown data for decreases in transmissivity:

$$s' = s-(s^2/2m) \quad (17)$$

where:

s' = drawdown that would occur in an equivalent artesian aquifer
s = observed drawdown under water-table conditions
m = initial saturated thickness of aquifer

The effects of gravity drainage also present challenging problems for the analysis of data because the field data deviate from the ideal upon which the Theis and Jacob methods are based. Several methods of data analysis have been presented by researchers, including Boulton (1963) and Neuman (1975). Neuman's method (1975) is designed for assessing anisotropic conditions. Prickett (1965) presented an application of the Boulton method (1963) that is useful for conditions under which anisotropy is not considered to be significant or critical to an assessment of the aquifer.

WELL AND AQUIFER TEST RESULTS

Production Well 11

The pumping well, Well 11, was finished at a depth of 50 feet (see appendix B). The bore hole for Well 11 was drilled 32-inches in diameter, and the well was built with 12-inch diameter steel casing and 12-inch-diameter, stainless steel, continuous-slot well screen. The well screen, with 40-slot openings (0.040 inch), 15 feet long, was placed between depths of 35 and 50 feet. Northern No. 0 gravel pack was placed in the annulus surrounding the well screen. The selection of the gravel pack and well screen were based on the sieve analysis of aquifer samples collected from a test hole at the site of Well 11 (see figure 7). The sieve data for the aquifer samples and the gravel pack are in appendix C. The well design suggestions were included in an ISWS letter dated July 12, 1996, included in appendix C. Three observation wells were used for the aquifer test (see appendix B for construction details). Observation Wells (OW) 1, 2, and 3 were completed with 2-inch diameter polyvinyl chloride (PVC) casing and sawed slots in the bottom 15 feet.

Test Protocol

Speth Plumbing, Inc., furnished and installed pumping equipment in the test well and discharge piping. Equipment to measure discharge rate and water levels, along with data-logging equipment, was furnished and installed by the ISWS in the test well and in the observation wells.

A step test was conducted on October 15, 1996, and a four-day aquifer test was conducted October 17-21, 1996. Pumped ground water was conducted from the well head through 4-inch diameter approach pipe and orifice tube to the nearby roadside ditch. The water then flowed west to a drainage ditch and south to Mint Creek. A valve at the well head was used to control the pumping rates, and an ISWS 4-inch orifice tube was used to measure discharge rates. Ground-water-level measuring equipment included In-Situ Hermit data-logging equipment and pressure transmitters in each well, supplemented with electric droplines.

Previous to the step test on October 15, 1996, an attempt to conduct a step test was made on October 4. During that step test the pumping capacity of the well was found to be less than expected, and the test had to be aborted during the third step. After further effort to develop the well, the step test reported here was conducted. The subsequent aquifer test, although planned

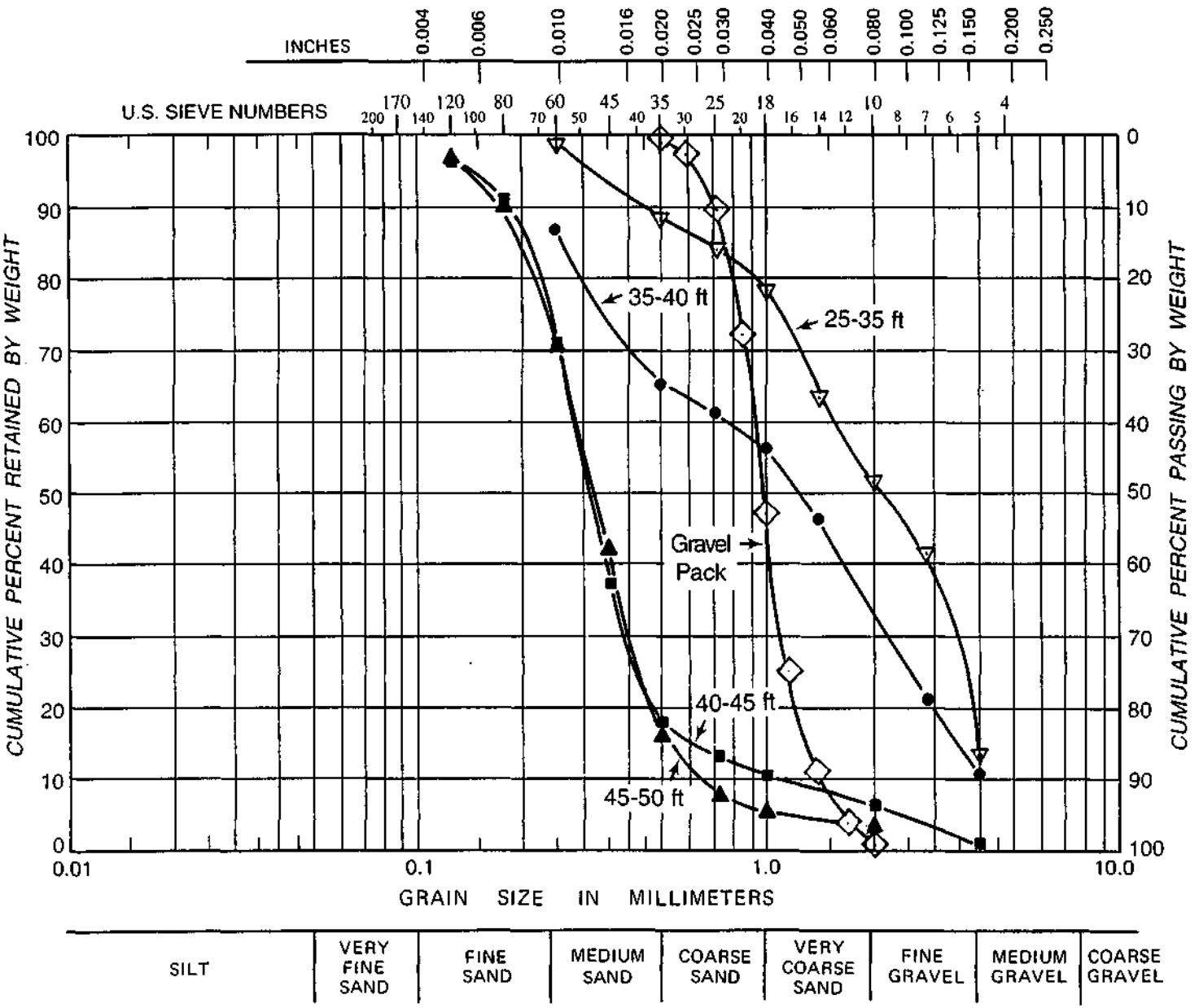

Figure 7. Sieve analyses of aquifer samples and gravel pack, Production Well 11

for seven days, was terminated involuntarily on the fourth day when the generator stopped and could not be restarted promptly.

Step Test

The step test on October 15, 1996, began at a rate of about 101 gpm and increased in approximately 20-gpm increments. Ideally, a minimum of three steps is necessary for analysis, and five steps are desirable. For this test, five 30-minute steps were conducted at rates of about 101, 121, 140, 160, and 180 gpm. Observed ground-water-level data for the step test are included in appendix D. The analysis of a water sample collected during the step test at 12:45 p.m. on October 15 is in appendix F.

Step Test Results

The data collected during the step test conducted on October 15, 1996, were analyzed using the Jacob (1947) step-test methodology described earlier. A regression analysis of the observed water-level data for each step made the data suitable for graphical analysis. The results of the analysis indicate that Well 11 had a relatively high well-loss coefficient of approximately 16.9 $sec V ft^5$ (see figure 8). The aquifer loss coefficient also was very high, suggesting that the sand-and-gravel aquifer at Well 11 was not as permeable as expected. Even with the high well loss coefficient, drawdown due to well loss (proportional to the square of the pumping rate) in the expected range of pumping rates, is a marginally acceptable 8 to 12 percent of the observed drawdown.

Four-Day Aquifer Test

The four-day aquifer test was conducted October 17-21, 1996. commencing at 11:40 a.m. on the 17th and ending when the generator stopped at 10:59 p.m. on the 21 st, a total pumping period of 5,719 minutes. Pumping at Well 11 was maintained at a constant discharge rate of about 144 gpm throughout the test. During the pumping period, water levels were measured in Well 11, TB 4, and OWs 1, 2, and 3, located 39.8 ft N, 92 ft S, 196 ft N. and 496 ft N, respectively, of Well 11. In addition, a barometric pressure transmitter was used to record changes in atmospheric pressure, and a staff gage was placed in the Embarras River to allow periodic observation of river stage fluctuations. Water-level data for the aquifer test are in appendix E. Analysis of a water sample collected at 5:00 p.m. on October 18, 1996, is in appendix F.

Four-Day Aquifer Test Results

The aquifer test data did not show the effects of the known barrier boundary (the bluffs), about 1,500 feet west of the well-field site. This may be due to changes in the storage coefficient at the pumped well. No adjustments to the collected data were made because of the influence of barometric pressure changes, which can influence ground-water level changes in some cases. These data show a range in barometric pressure of only about 14.37 to 14.48 pounds per square inch absolute or psia (33.15 to 33.41 feet of water or 29.27 to 29.48 inches of mercury or Hg)

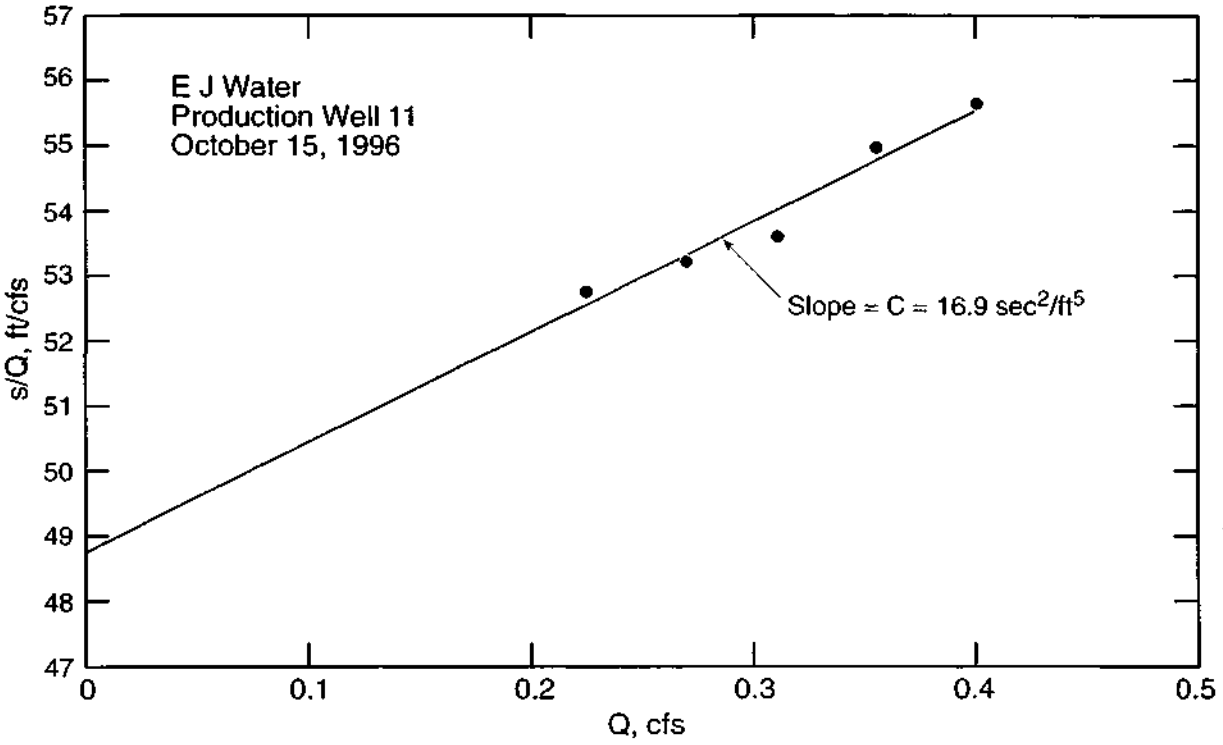

Figure 8. Graphical solution of Jacob's equation for well-loss coefficient, C, for E J Water Corporation Well 11

during the aquifer test period (see appendix E). These barometric changes were judged small enough to have little or no effect on the collected ground-water level data. Observations of barometric pressure and ground-water levels in OW 1 from October 4-17 before the aquifer test did not suggest a strong influence of barometric pressure on ground-water levels at this site (see appendix G). Time-drawdown graphs of the data were then constructed and analyzed, using the Type-Curve (Boulton/Prickett) and Straight-Line (Jacob) methodologies. The time-drawdown graph of observed water level data for OW 2 and the type curve match is shown in figure 9.

Analysis of the data collected from Well 11, TB 4, and OWs 1 and 2 indicated the transmissivity of the sand-and-gravel aquifer at the time of the test ranged from about 38,000 to 42,700 gpd/ft as shown in table 1, and averaged about 39,900 gpd/ft (hydraulic conductivity of about 1140 gpd/ft^2). The analysis of data from OW 3 indicated a transmissivity of about 51,500 gpd/ft. The storage coefficient of the aquifer ranged from about 4.9×10^{-4} to 1.4×10^{-3}, indicative of artesian conditions. None of the observation well data indicated the presence of the aquifer boundary during the test period.

Idealized Aquifer Model

With the test results, a theoretical idealized model of the aquifer conditions in the vicinity of Well 11 was hypothesized. The aquifer model was a semi-infinite aquifer extending north, east, and south beyond the cone of depression. A barrier boundary was assumed to be located about 1,500 feet west of the well-field site. Although ostensibly conservative, this assumption is reasonably consistent with the known regional extent of the sand-and-gravel aquifer system associated with the Embarras River bottomlands, and it does not reduce the yield of a well field to less than the desired quantity.

Table 1. Results of Four-Day Aquifer Test, Well 11

	Straight-Line Method			*Type-Curve Method*		
Well	*T* (gpd/ft)	*K* (gpd/ft^2)	*S*	*T* (gpd/ft)	*K* (gpd/ft^2)	*S*
P W 1 1	38,000	1200	-	-	-	-
TB 4	39,200	1090	0.00046	38,400	1070	0.00049
OW 1	39,200	1240	0.0028	39,300	1245	0.0033
OW 2	42,700	1060	0.0011	42,300	1050	0.0011
OW 3	51,400	1560	0.0014	51,600	1560	0.0014

Notes:
PW = production well
TB = test boring
OW = observation well
T = transmissivity
K = hydraulic conductivity
S = storage coefficient

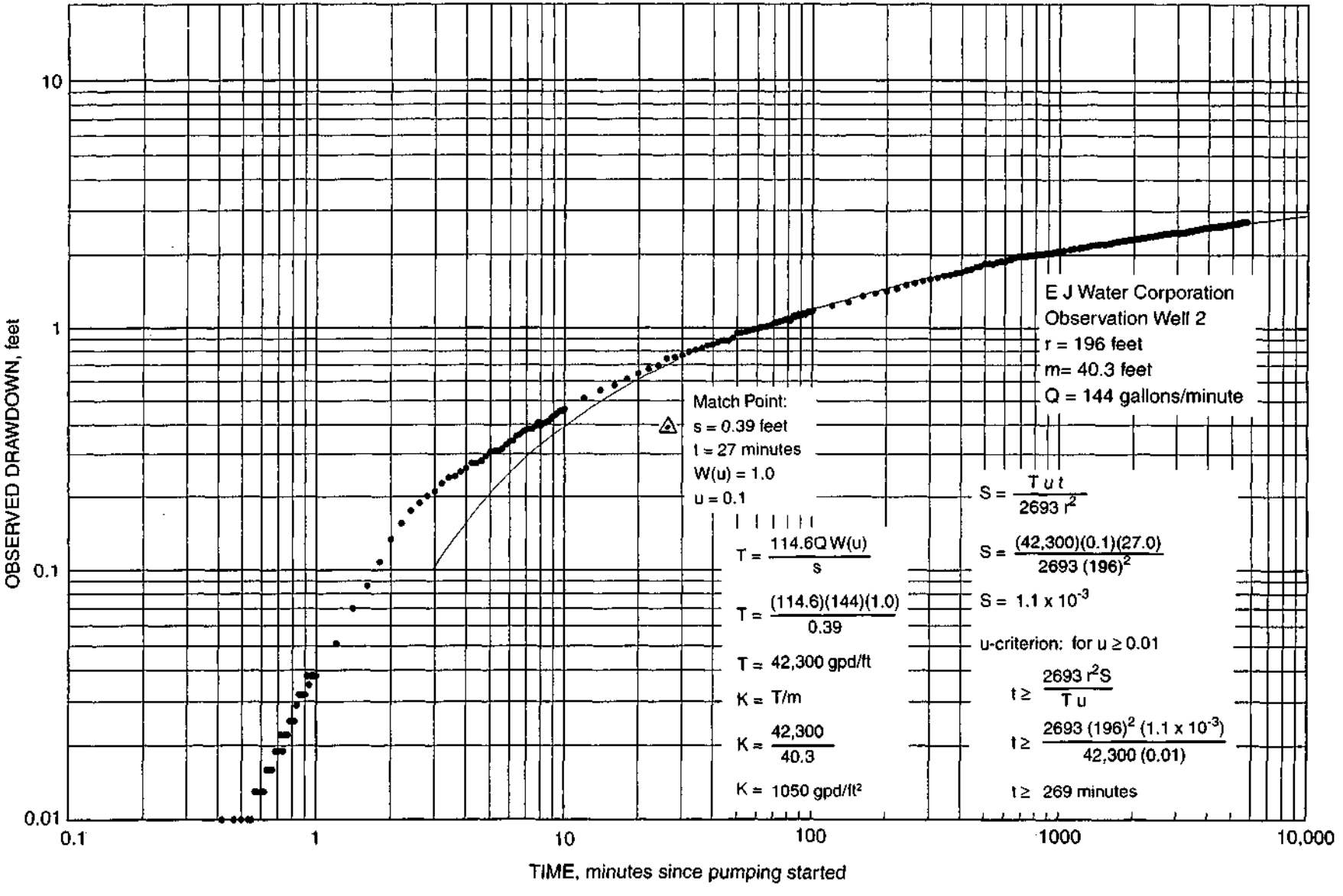

Figure 9. Type curve of OW2 observed water-level data, Well 11 aquifer test

The yield of a shallow sand-and-gravel aquifer also must take into account effects on ground-water levels by a drought period (180 days without ground-water recharge). In this case, there are no data available to indicate how much natural decline in ground-water levels might occur during these periods. Experience with other similar areas indicates that ground-water levels during drought periods might be about 3 feet lower than at the time of the aquifer test. Ground-water levels at the time of the aquifer test were near the top of the sand-and-gravel aquifer. These lowered ground-water levels have the effect of reducing the saturated thickness of the sand-and-gravel aquifer, reducing the effective transmissivity of the aquifer, and reducing the available drawdown in production wells. However, ground-water levels within the interval of sand and gravel cause a large increase in storage coefficient. Our experience under similar aquifer conditions has shown that an assumed value of 0.1 for storage coefficient is reasonably conservative and allows representative well yields to be estimated.

Thus the model aquifer consisted of the following elements: 1) a transmissivity of about 34,200 gpd/ft, 2) a specific yield of 0.1, and 3) a barrier boundary at a distance of about 1,500 feet west of the well field.

Using the hydraulic properties of the model aquifer, a theoretical distance-drawdown graph was constructed to estimate the effects of the assumed boundary and the mutual drawdown interference effects between production wells. Allowance was made for dewatering up to 50 percent of the saturated thickness of the aquifer at the production well sites by adjusting drawdowns for the decrease in transmissivity.

Model Results

Based on the assumptions and conditions described, the idealized model aquifer, and resulting calculations of drawdown and interference effects, a well-field yield of about 300 gpm (432,000 gpd) is feasible from three production wells (100-gpm each) spaced at about 250 feet in a line trending north-south along the edge of the parcels of land. Each production well may be equipped with about 10-12 feet of well screen and the well pump intake positioned no lower than the top of the well screen.

These results were conveyed to the E J Water Corporation by letter dated November 18, 1996 (appendix L), and in a subsequent meeting with officials of the E J Water Corporation and their consulting engineer on December 5, 1996. The discussion revealed that a much preferred option for the present would be to operate only one production well at the second (south) well field to match the expanded treatment rate at the water treatment plant. Calculations suggested that operating one well at the 200-gpm rate probably was not feasible on a long-term basis, especially during drought conditions. But because aquifer hydraulic properties at the site of OW 3, about 500 feet north of Well 11, appeared somewhat better than at other sites, the corporation could construct the second production well (Well 12) at that site. If an aquifer test revealed that the 200-gpm rate was feasible from that production well (Well 12), then Well 11 would be capped and retained for later incorporation into the system. If Well 12 could not be pumped at the desired 200-gpm rate, Well 11 would be completed and each production well pumped at a rate of 100 gpm to achieve the desired 200-gpm rate to match the treatment plant expansion.

As a result of the meeting on December 5, 1996, the corporation and their consulting engineer elected to proceed with the construction of the second production well near OW 3. A 24-hour aquifer test would be cooperatively conducted with the ISWS, and the data would be analyzed to determine whether a single production well at the site of OW 3 could be used to obtain the desired 200-gpm supply.

Subsequently, the selected site for Well 12 was about 30 feet east of OW 3. A test hole at this site was drilled to collect sand-and-gravel formation samples for sieve analysis. The sieve data showed the texture of the sand-and-gravel aquifer in the interval to be screened (about 40 to 50 ft) to be noticeably finer grained than at OW 3 (see figure 10 showing sieve analyses of aquifer samples and appendix H for sieve data). This change in aquifer texture was not expected but is not unusual in the depositional environment present in the Embarras River valley area. A recommendation was made to locate Well 12 as close to OW 3 as easement and well superstructure design would permit. Design suggestions for Well 12 were made based on both sets of sieve data plus an alternate design that would allow for some textural change from the OW 3 site to a close offset site for Well 12 (see letter dated June 2, 1997, appendix H).

For the aquifer test using Well 12, an additional observation well (OW 4) was constructed about 53 feet south of Well 12. This observation well was location between OWs 2 and 3 that were used during the aquifer test with Well 11.

Production Well 12

Well 12 was finished at a depth of 48 feet (see appendix B). The bore hole for Well 12 was drilled 32-inches in diameter, and the well was built with 12-inch diameter steel casing and a 12-inch-diameter, stainless steel, continuous-slot well screen. The well screen, with 80-slot openings (0.080 inch), 10 feet long, was placed between depths of 38 and 48 feet. Northern No. 3 gravel pack was placed in the annulus surrounding the well screen. The selection of the gravel pack and well screen were based on the sieve analysis of aquifer samples collected from a test hole near the site of Well 12 and from aquifer samples collected from nearby OW 3 (see figure 10). The sieve data for the aquifer samples and the gravel pack are presented in appendix H. The well design suggestions were included in an ISWS letter dated June 2, 1997 (appendix H). Four observation wells were used for the aquifer test (see appendix B for construction details). The OWs 1, 2, 3, and 4 were completed with 2-inch diameter PVC casing and sawed slots in the bottom 15 feet.

At the recommendation of the drilling contractor, a 2-inch diameter piezometer was placed within the gravel pack in the annulus between the casing-well screen assembly and the borehole. The piezometer will allow easy access for future measurement of nonpumping water levels and approximate measurement of pumping water levels. In addition, the gravel pack piezometer may be helpful in diagnosing well deterioration problems if they occur in the future.

Water levels were observed in this piezometer during the step test and the aquifer test and are included in the tabulated data in appendices I and J. Information on the construction features of the piezometer are in appendix B.

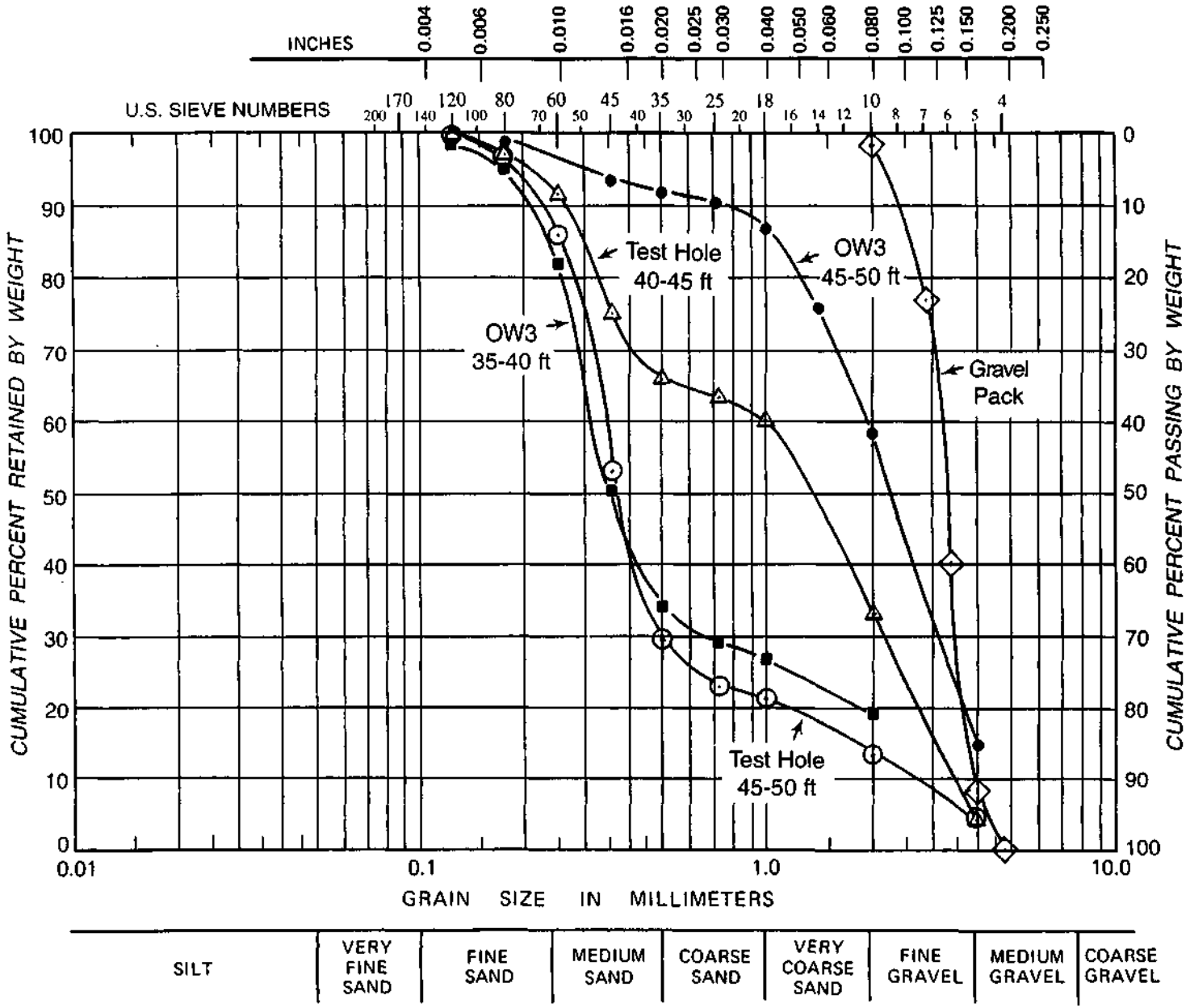

Figure 10. Sieve analyses of aquifer samples and gravel pack, Production Well 12

Test Protocol

Speth Plumbing, Inc., furnished and installed pumping equipment in the test well and discharge piping. Equipment to measure discharge rate and water levels, and data-logging equipment, was furnished and installed by the ISWS in the test well and observation wells.

A step test was conducted on July 31, 1997, and a 24-hour aquifer test was conducted August 5-6, 1997. Pumped ground water was conducted from the well head through 4-inch diameter approach pipe and orifice tube to a temporary field ditch to the nearby roadside ditch. The water then flowed west to a drainage ditch and south to Mint Creek. A valve at the well head was used to control the pumping rates, and an ISWS 4-inch orifice tube was used to measure discharge rates. Ground-water-level measuring equipment included In-Situ Hermit data-logging equipment and pressure transmitters in each well, supplemented with electric droplines.

Step Test

The step test on July 31, 1997, began at a rate of about 200 gpm and increased in approximately 20-gpm increments. Ideally, a minimum of three steps is necessary for analysis, and five steps are desirable. For this test, five 30-minute steps were conducted at rates of about 200, 220, 240, 260, and 280 gpm. Observed ground-water-level data for the step test are included in appendix I.

Step Test Results

The data collected during the step test conducted on July 31, 1997, were analyzed using the Jacob (1947) step-test methodology described earlier. A regression analysis of the observed water-level data for each step made the data suitable for graphical analysis. The results of the analysis indicate that Well 12 had a moderate well-loss coefficient of approximately 3.7 sec^2/ft^5 (figure 11). The aquifer loss coefficient also was relatively high, suggesting that the sand-and-gravel aquifer at Well 12 was not as permeable as hoped. Drawdown due to well loss (proportional to the square of the pumping rate) in the expected range of pumping rates is an acceptable 3 to 5 percent of the observed drawdown.

24-Hour Aquifer Test

The 24-hour aquifer test was conducted August 5-6, 1997, commencing at 12:20 p.m. on the 5th and ending at 11:40 a.m. on the 6th, a total pumping period of 1,400 minutes. Pumping at Well 12 was maintained at a constant discharge rate of about 219 gpm throughout the test. During the pumping period water levels were measured in Well 12, Well 11 (as on observation well) located 475 ft S, and in OWs 1, 2, 3, and 4, located about 556 ft S, 281 ft S, 24 ft NW, and 53 ft S, respectively, of Well 12. In addition, a barometric pressure transmitter was used to record changes in atmospheric pressure, and a staff gage was placed in the Embarras River to allow periodic observation of river stage fluctuations. Water-level data for the aquifer test are in

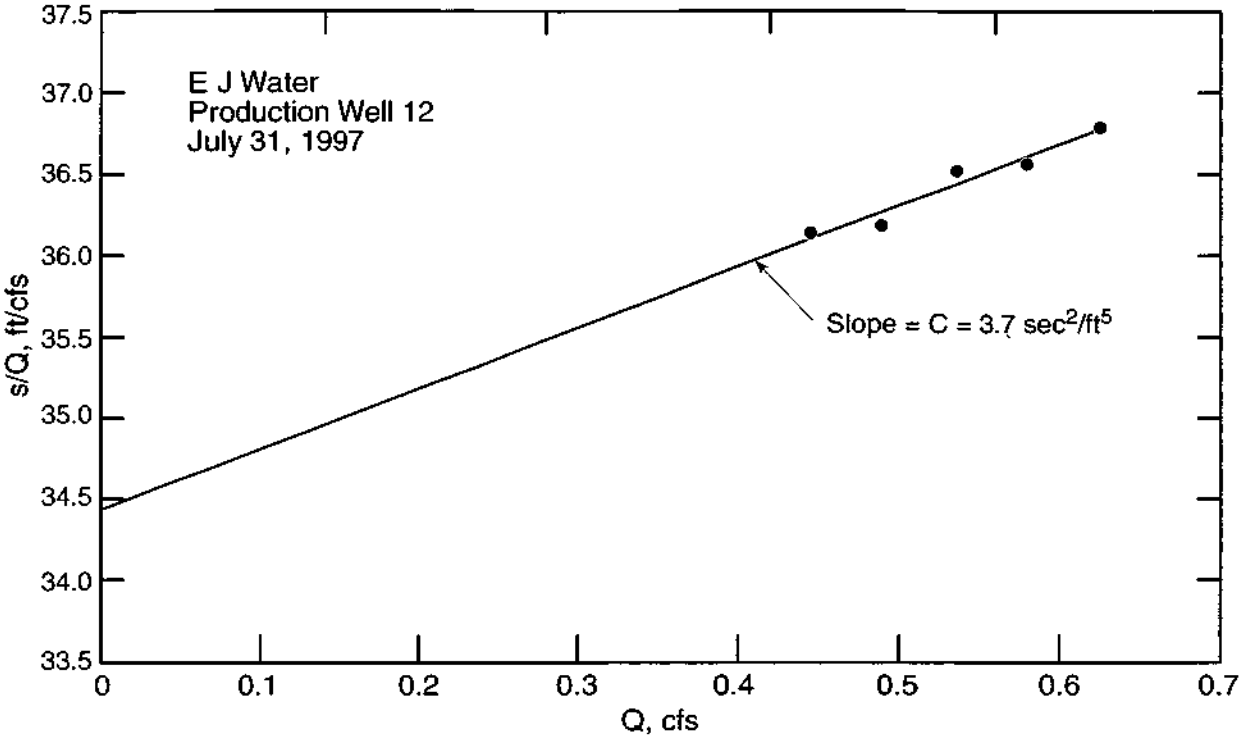

Figure 11. Graphical solution of Jacob's equation for well-loss coefficient, C, for E J Water Corporation Well 12

appendix J. Analysis of water samples collected at 2:50 p.m. on August 5 and at 11:20 a.m. on August 6 are in appendix K.

24-Hour Aquifer Test Results

As with the aquifer test with Well 11, these aquifer test data also did not show the effects of the known barrier boundary (the bluffs) about 1,500 feet west of the well field site. This may be due to changes in the storage coefficient at the pumped well. No adjustments to the collected data were made because of the influence of barometric pressure changes, which can influence ground-water level changes in some cases. These data show a range in barometric pressure of only about 14.53 to 14.60 psia (33.52-33.68 feet of water or 29.58-29.72 inches of Hg) during the aquifer test period (appendix J). These barometric changes were judged small enough to have little or no effect on the collected ground-water level data. Time-drawdown graphs of the data were then constructed and analyzed, using the Type-Curve (Boulton/Prickett) and Straight-Line (Jacob) methodologies. The time-drawdown graph of observed water level data for OW 2 and the type curve match is shown in figure 12 to illustrate the analysis.

Analysis of the data collected from Well 12, Well 11, and OWs 1,2,3, and 4 indicated the transmissivity of the sand-and-gravel aquifer at the time of the test ranged from about 40,400 gpd/ft to 44,800 gpd/ft as shown in table 2, and averaged about 42,250 gpd/ft (hydraulic conductivity of about 1,170 gpd/ft^2). The storage coefficient of the aquifer ranged from about 9.0 x 10^{-4} to 1.4 x 10^{-3}, indicative of artesian conditions. None of the observation well data indicated the presence of the aquifer boundary during the test period.

Table 2. Results of 24-Hour Aquifer Test, Well 12

	Straight-Line Method			*Type-Curve Method*		
Well	*T (gpd/ft)*	*K (gpd/ft^2)*	*S*	*T (gpd/ft)*	*K (gpd/ft^2)*	*S*
PW 12	41,300	1250	-	-	-	-
PW 11	41,300	1000	0.0011	41,150	1000	0.0011
OW 1	40,400	1190	0.0013	40,500	1190	0.0014
OW 2	44,500	1035	0.00088	44,800	1040	0.0009
OW 3	42,200	1280	-	42,500	1290	-
OW 4	42,800	1300	-	43,300	1300	-

Notes:
PW = production well
OW = observation well
T = transmissivity
K = hydraulic conductivity
S = storage coefficient

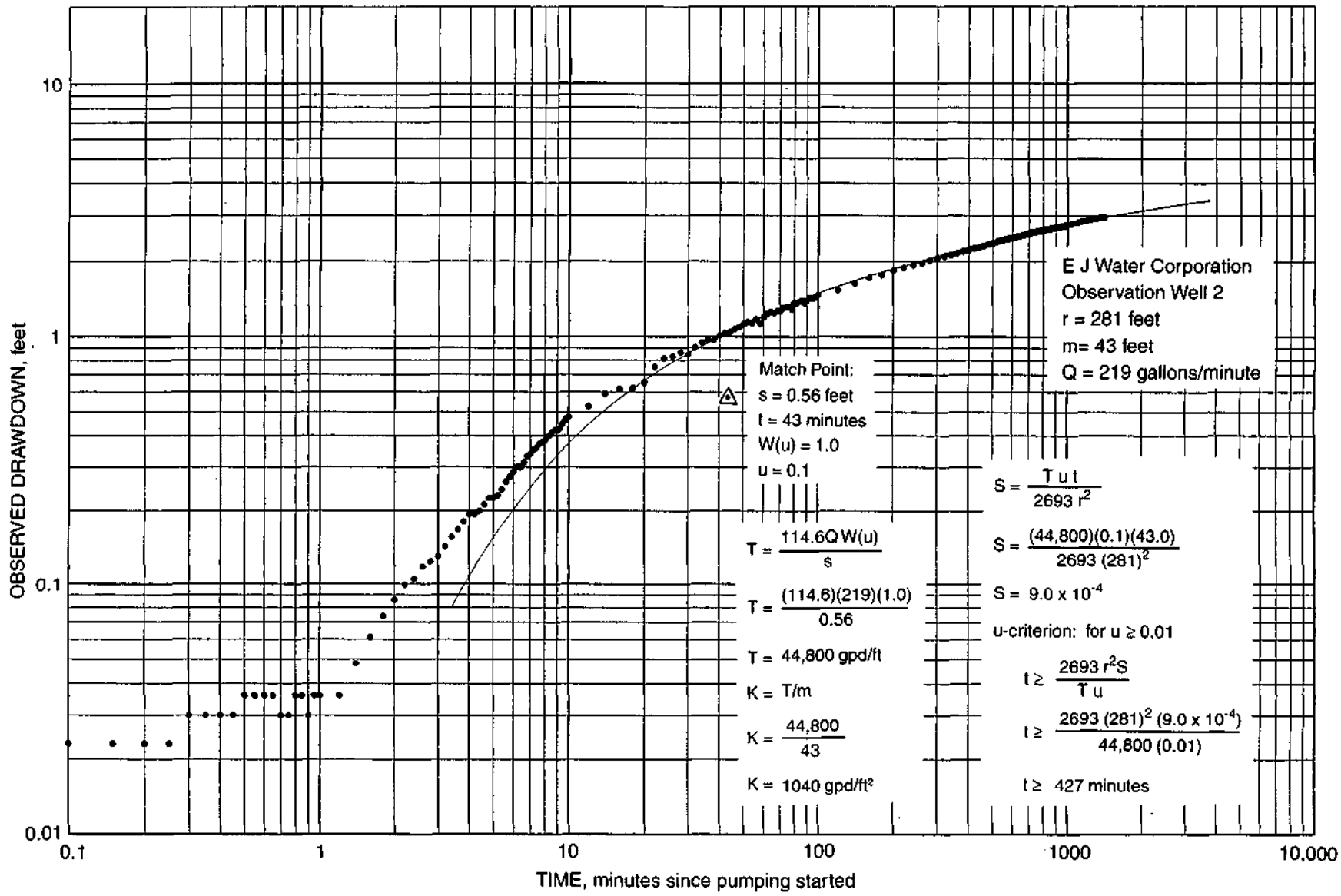

Figure 12. Type curve of OW2 observed water-level data, Well 12 aquifer test

Idealized Aquifer Model

As with the analysis of data from Well 11, a similar theoretical idealized model of the aquifer conditions in the vicinity of Well 12 was hypothesized. The aquifer model was a semi-infinite aquifer extending north, east, and south beyond the cone of depression. A barrier boundary was assumed to be located about 1,500 feet west of the well field site.

Effects on the yield of this shallow sand-and-gravel aquifer by a drought period must be taken into account. As indicated earlier, there are no data available to indicate how much natural decline in ground-water levels might occur during droughts. Ground-water levels in August 1997 compared to water levels in October 1996 were about 3 feet higher. Accordingly, to make this aquifer evaluation comparable to that using the Well 11 test data, the assumption was made that ground-water levels during drought periods may be about 6 feet lower than at the time of the aquifer test. Ground-water levels at the time of the aquifer test were marginally above or near the top of the sand-and-gravel aquifer; therefore these lowered ground-water levels have the effect of reducing the saturated thickness of the sand-and-gravel aquifer, reducing the effective transmissivity of the aquifer, and reducing the available drawdown in production wells. However, ground-water levels within the interval of sand and gravel cause a large increase in storage coefficient, and an assumed value of 0.1 for storage coefficient was used in calculations as for the previous evaluation using data from the aquifer test with Well 11.

Thus the model aquifer consisted of the following elements: 1) a transmissivity of about 40,100 gpd/ft, 2) a specific yield of 0.1, and 3) a barrier boundary at a distance of about 1,500 feet northwest of the well field. The transmissivity of the aquifer used in this re-evaluation of the well field is about 17 percent greater than that used with the data from the Well 11 aquifer test due primarily to a more representative method of calculating the average thickness of the sand-and-gravel aquifer in the vicinity of the well field under drought conditions.

Using the hydraulic properties of the model aquifer, a theoretical distance-drawdown graph was constructed to estimate the effects of the assumed boundary and the mutual drawdown interference effects between production wells. Allowance was made for dewatering up to 50 percent of the saturated thickness of the aquifer at the production well sites by adjusting drawdowns for the decrease in transmissivity.

Model Results

Based on the assumptions and conditions described here, the idealized model aquifer, and resulting calculations of drawdown and interference effects, the re-evaluation of well-field yield using data from the Well 12 aquifer test confirmed that a well-field yield of about 300 gpm (432,000 gpd) is feasible from three production wells (100 gpm each) spaced at about 250 feet in a line trending north-south along the edge of the parcels of land. Each production well may be equipped with about 10-12 feet of well screen, and the well pump intake positioned no lower than the top of the well screen. This re-evaluation also suggested that the well-field yield might be expanded to as much as 400 gpm (576,000 gpd) with a fourth production well spaced 250 feet south (or perhaps north) of the line of three production wells. It is not certain if this increased

yield could be sustained during a drought period. Further analysis of the test data indicates that Well 12 can be operated at the desired rate of about 200 gpm. However, when increased production capacity is needed, it will be necessary to add the third and fourth production wells (Wells 13 and 14) and install 100 gpm pumps in each production well.

These results were conveyed to the E J Water Corporation by letter dated September 5, 1997 (appendix L).

CONCLUSION

This ground-water investigation in the bottomlands of the Embarras River valley confirmed the presence of a sand-and-gravel aquifer worthy of development for additional water supply for the E J Water Corporation. Based on the results of the aquifer testing described, the yield of a properly developed and managed well field may be as much as 400 gpm (576,000 gpd), even during drought conditions. The evaluation confirms that a yield of 300 gpm (432,000 gpd) should be sustainable during a drought period. It is prudent, however, to also recommend that water levels in the well field be measured on a regular basis, after the well field is placed into production, to monitor the long-term response of the aquifer to ground-water withdrawals. Therefore, close monitoring of the relationship between long-term pumpage and water levels at the production well site is a wise and desirable management policy for operation of this new (south) well field as well as the first (north) well field. Separate metering of the ground-water withdrawals from each well or well field will be necessary to establish the relationship between pumpage and ground-water levels.

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Appendix A.

Preliminary Reports and Test Boring Information

Illinois State Geological Survey

Natural Resources Building
615 East Peabody Drive
Champaign, IL 61820-6964
217/333-4747
FAX 217/244-7004

Illinois Department of
Energy and Natural Resources

December 2, 1994

Mr. Delbert Mundt
E.J. Water Corporation
Box 8
Dieterich, IL 61424

Dear Mr. Mundt:

Enclosed is a report summarizing a reconnaissance electrical earth resistivity survey for the E. J. Water District, conducted October 25-26, 1994, in Sections 3, 10, 11, 14 and 15, T. 7 N., R. 9 E., Jasper County, Illinois.

Very truly yours,

Philip C. Reed
Staff Geologist
Groundwater Resources and
Protection Section

Timothy C. Young
Assistant Staff Geographer
Groundwater Resources and
Protection Section

PCR:ey

Enclosure

cc: -State Water Survey
-Illinois EPA (2)
-Mr. Patrick J. Milano
Milano & Grunloh Engineers
211 N. Third St
P.O. Box 897
Effingham, IL 62401

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Illinois Department of
Energy and Natural Resources

December 2, 1994

A SUPPLEMENTAL ELECTRICAL EARTH RESISTIVITY SURVEY FOR THE E. J. WATER CORPORATION, SECTIONS 3, 10, 11, 14 AND 15, T. 7 N., R. 9 E., JASPER COUNTY, ILLINOIS

By

Philip C. Reed, Staff Geologist
Timothy C. Young, Assistant Staff Geographer
Groundwater Resources and Protection Section

Introduction

At the request of Mr. Delbert Mundt of E. J. Water Corporation, Box 8, Dieterich, Illinois 61424, an electrical earth resistivity survey was conducted west of Falmouth on the west side of the Embarras River on October 25-26, 1994. The purpose of the geophysical survey was to locate a deposit of water-bearing sand and gravel from which a supplemental supply of water could be obtained for the E. J. Water Corporation. The work was accomplished with the competent assistance of Mr. Dan Mahaffey, Mr. Michael Hall, Mr. Lowell Kepley and Mr. Clarence Vahling. Geologic reports forwarded in 1989 and 1991, gave information on the groundwater conditions in the area of request.

Hvdrogeologic Framework

The area is situated on ice-deposited materials (outwash sand and gravel and glacial drift) of Holocene, Wisconsinan, and possibly older age. These earth materials consist of as much as 60 feet of silt, clay and sand, and sand and gravel. In places, layers of sand and gravel may reach a thickness of 40 feet and be capable of yielding up to 450 gpm (gallons per minute) to a properly constructed well.

The bedrock beneath the drift consists predominantly of shale with beds of sandstone and limestone of Pennsylvanian age and is not considered an important municipal aquifer in the request area.

Resistivity Survey

The electrical earth resistivity survey is based on the principle that compact glacial till and shale present less resistance to the passage of an electric current than sand and gravel of the glacial drift, or sandstone and limestone of the bedrock. The purpose of the survey is to test the earth materials above the bedrock in order to obtain a basis for recommendations for test drilling. The accompanying duplicated topographic map shows the approximate location of the 79 stations (nos. 126-204) occupied during the course of the survey. The stations which are arranged into five, east-west alignments and from north to south include alignment no. 1 (station nos. 162-

173), alignment no. 2 (stations nos. 145-161), alignment no. 3 (station nos. 174-197), alignment no. 4 station nos. 126-144) and no. 5 (station nos. 198-204). All of the stations were marked with numbered flags placed into the ground at intervals generally of about 300 feet.

Conclusions

The best alignments for testing are alignments 4 and 5 with alignment no. 5 better than no. 4. The most favorable area for testing is shown by the hachures on the accompanying map.

Alignment 4

1) We suggest testing along the east-west road in the vicinity of station nos. 134 and 135. Station no. 135 is situated approximately 2850 feet east of the N-S drainage ditch and the intersection of the east-west road. The drainage ditch referred to flows southward near the middle of Sections 10 and 15, T. 7 N., R. 9 E., Jasper County. Station no. 134 is situated 300 feet west of Station no. 135.

Alignment 5

2) We also suggest testing in the vicinity of station no. 204 situated approximately 1200 feet south of station no. 135.

The testing should be performed by a driller capable of constructing a gravel-packed well in the depth range of 50-100 feet in sand and gravel.

We would anticipate that the sand and gravel deposit in Sections 10 and 15, T. 7 N., R. 9 E., Jasper County, will have similar hydrogeologic characteristics comparable to the present well field situated in Section 34, T 8 N., R. 9 E., Jasper County.

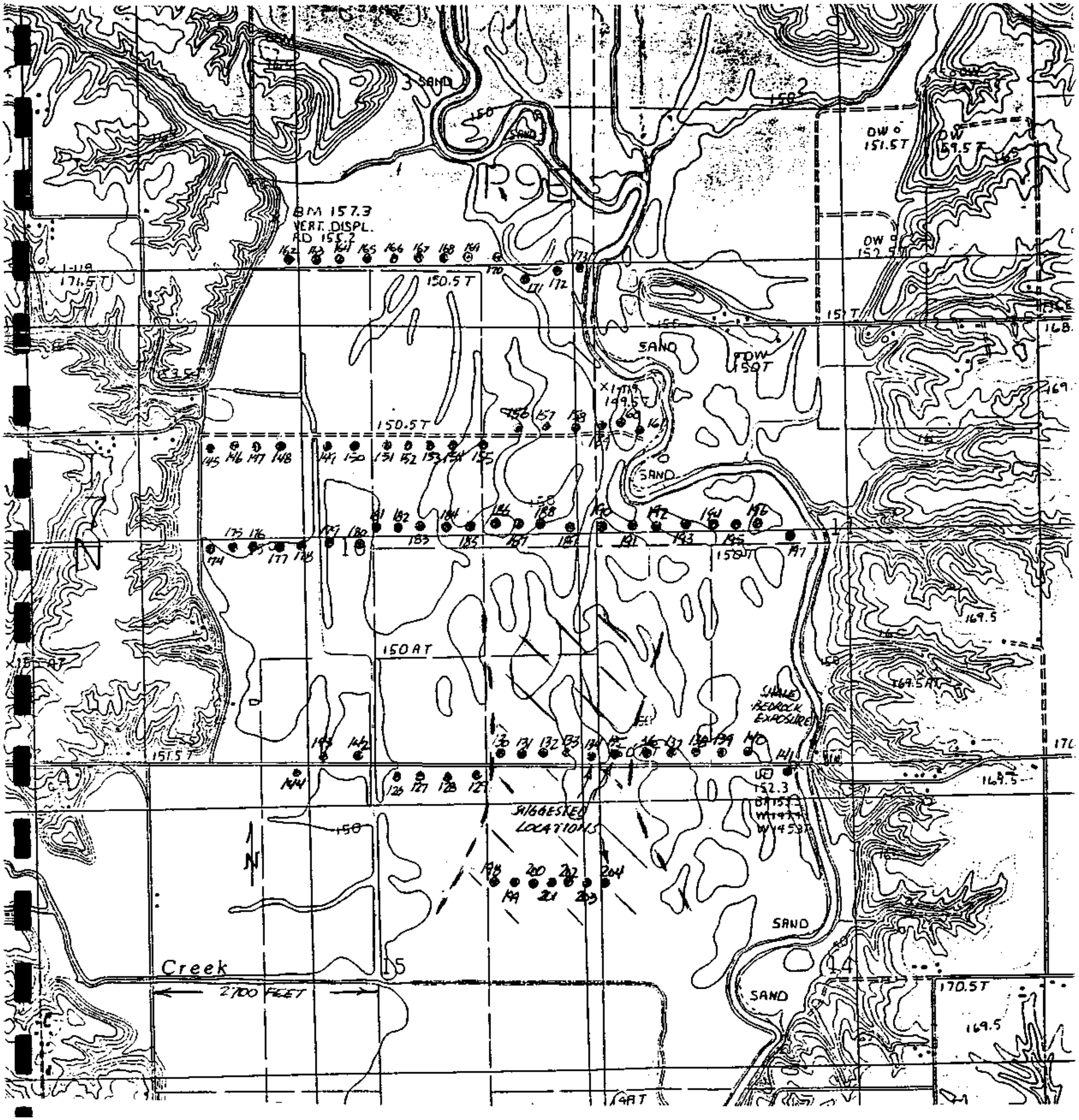
In order to evaluate the results of this survey more fully, we request that electric and gamma logging be done on all the test holes drilled. The Geological Survey has the instrumentation for this type of logging and will be glad to perform the service, without charge, provided enough lead time is given for scheduling the instrument.

The Illinois Water Use Act (Public Act 83-700) requires any person who proposes to develop a water well with a capacity in excess of 100,000 gallons on any given day (70 gpm) to notify the County Soil and Water Conservation District. The purpose of the Act is to establish a means of reviewing potential water-use conflicts before damage is incurred. The Act is not intended to restrict or regulate groundwater withdrawals.

Please furnish the Geological Survey the following information on any new well or test holes drilled: location (section, township, range including distance and direction to nearby buildings and roads); driller's log recording all formations penetrated along with well completion data (screen, cementing and casing records; water levels, tested yield, and appearance of water); and any other information that you deem pertinent. This information will be placed into files at the Survey for future reference.

Any future correspondence referring to this report should be addressed to the State Geological Survey, 615 E. Peabody Drive, Champaign, Illinois, 61820.

RP2EER.Mundt



A SUPPLEMENTAL ELECTRICAL EARTH RESISTIVITY SURVEY FOR THE E. J. WATER CORPORATION IN SECTIONS 3, 10, 11, 14 AND 15, T. 7 N., R. 9 E., JASPER COUNTY, ILLINOIS

October 25-26, 1994

Philip C. Reed
Timothy C. Young

Groundwater Resources Section
Illinois State Geological Survey, 615 E. Peabody Drive, Champaign, IL 61820

ILLINOIS
DEPARTMENT OF
NATURAL
RESOURCES

ILLINOIS STATE GEOLOGICAL SURVEY

Natural Resources Building
615 East Peabody Drive
Champaign, IL 61820-6964
217/333-4747
FAX 217/244-7004

May 15, 1996

Mr. Delbert Mundt
E. J. Water Corporation
Box 8
Dieterich, IL 61424

Dear Mr. Mundt:

Enclosed is a report summarizing the results of the borehole logging conducted in the observation wells at the production well field site and the test holes at the Loveford and Rafetown sites in Jasper County, Illinois.

We would like to thank Dan MaHaffey and Dave Klitzing for their assistance and patience in the completion of the borehole logging at these test sites. Thanks also to Jim Speth who did a wonderful job in describing the earth materials through test drilling.

Very truly yours,

Timothy C. Young
Assistant Staff Geologist
Groundwater Resources and Protection Section

Philip C. Reed
Staff Geologist
Groundwater Resources and Protection Section

TCY/PCR:ey

Enclosures

cc: -Mr. Ellis Sanderson
State Water Survey
-Illinois EPA (2)

-Mr. Patrick J. Milano
Milano & Grunloh Engineers
211 N. Third St
P.O. Box 897
Effingham, IL 62401

L-Rptlog.Mun

ILLINOIS
DEPARTMENT OF NATURAL RESOURCES

ILLINOIS STATE GEOLOGICAL SURVEY

Natural Resources Building
615 East Peabody Drive
Champaign, IL 61820-6964
217/333-4747
FAX 217/244-7004

April 30, 1996

REPORT ON THE GEOPHYSICAL LOGGING FOR THE E. J. WATER CORPORATION IN SECTION 34, T. 8 N., R. 9 E. (PRESENT WELL FIELD), AND IN SECTIONS 10, 14 AND 15, T. 7 N., R. 9 E. (RAFETOWN), JASPER COUNTY, ILLINOIS

BY

TIMOTHY C. YOUNG AND PHILIP C. REED
GROUNDWATER RESOURCES AND PROTECTION SECTION

INTRODUCTION

This report on the lithologic and hydrogeologic characteristics of the earth materials at test sites 1 through 11 in Sections 10, 14 and 15, T. 7 N., R. 9 E. (Loveford) and test sites 1 through 5, in Section 20, T. 5 N., R. 14 W. (Rafetown) in Jasper County, Illinois, was prepared as a contract arrangement with the E. J. Water Corporation to further characterize the groundwater potential for the Corporation in the lowland of the Embarrass River west of Falmouth (Loveford area) and east of Rafetown (see prior reports of April 26-27 and October 25-26, 1996). The Loveford and Rafetown surveyed areas are south of the present E. J. Water Corporation well field located in Section 34, T. 8 N., R. 9 E., Jasper County, where three 10-inch diameter wells, about 50 feet in depth, are capable of pumping 300 gpm (gallons per minute). The logging was completed on February 16, 1996. Arrangements for the geophysical logging utilizing gamma ray neutron and density logs were made through Mr. Delbert Mundt with the assistance of Mr. Dan Mahaffey and Dave Klitzing, E. J. Water Corporation, P.O. Box 8, Dieterich, Illinois 61424, with the cooperation of driller Mr. Jim Speth, Speth Incorporated, Allendale, Illinois 62410. Geophysical logging was used to help correlate results from the resistivity survey and test drilling. Mr. Patrick J. Milano, Milano and Grunloh Engineers, 211 N. Third Street, P.O. Box 897, Effingham, Illinois 62401, and Mr. Ellis W. Sanderson, P.E., Senior Engineer, Office of Ground-Water Resources Evaluation and Management, Illinois State Water Survey, Hydrology Division, 2204 Griffith Drive, Champaign, Illinois 61820, are actively assisting with the plans and programs of the E. J. Water Corporation.

The geophysical logging was completed on observation wells nos. 1 and 2 at the Corporation well field and on test well no. 4 in the Loveford area, and at test well no. 3 near Rafetown, Jasper County, Illinois. Differences in log configuration coverage can be attributed to lithologic character, casing type and size, well water levels (density and neutron were not run out of water) and well construction (grouting or backfilling). Two separate runs are required to complete the logs, one for the combined gamma and neutron, and one for the density.

BOREHOLE GEOPHYSICAL LOGGING

Borehole geophysical logging at the Illinois State Geological Survey (ISGS) is under the supervision of Ms. Beverly L. Herzog, Senior Hydrogeologist and Head, Groundwater Resources and Protection Section. The geophysical logging program's primary goal is to record the insitu physical and chemical properties of earth materials in and around a borehole to aid in groundwater and environmental investigations.

Geophysical logging at the Illinois State Geological Survey is accomplished with an upgraded Model 3500 truck-mounted analog system built by Gearhart-Owen Industries and Mineral Logging Systems (Halliburton Energy Services) and modified to digital by Mt. Sopris Instrument Company, Inc., in 1994. The ISGS conducts downhole logging with as many as ten types of hydrogeologic sensing devices commonly known as tools, probes or sondes, which are run sequentially in boreholes that are cased, uncased, fluid or air filled. Survey sondes, ranging in length from 3.0-14.7 feet and in diameter from 1.69-2.2 inches, are lowered into a well or borehole attached to the end of a 1/8-inch 3500 foot four-conductor armored cable. The cable is raised and lowered using a winch with a measuring device to show depth. The cable is connected to an electrical control panel and a lap-top computer. A computer records downhole signals digitally from four channels as the sonde passes through the earth materials providing a continuous insitu record. Since the downhole signals are recorded and stored on computer, the logs can be analyzed and reproduced at any scale desired.

The geophysical methods described in this report are best used to help locate the optimum site within a study area for well production. Resistivity surveys help to locate the best potential sites for test drilling and borehole logging. Borehole logging and test drilling help to confirm results of the eer survey by describing the lithology of the earth materials surrounding the

borehole and aids in proper well construction and screen placement. Borehole logs are also very useful for correlating lithology from one well location to the next by recording certain physical characteristics of the earth materials within a borehole.

The proper way of determining long term productivity and yield of an aquifer is by conducting pump tests for hydraulic conductivity utilizing strategically placed observation wells for recording drawdown and recovery rates within the aquifer. Pump tests performed by the Water Survey will help to give long range expectations for current and future well field production sites.

The following discussion describes the general principles of operation for the density, gamma, and neutron logs.

Density Log

The density log is a record of the approximate rock density determined by the back scatter of radiation from a 125-millicurie Cesium-137 gamma ray source measured along with the secondary emission from the lithology surrounding the borehole. The gamma ray flux is inversely proportional to the bulk density, therefore density increases when secondary emission decreases (the lower CPS the higher the density). Dense rock materials (i.e., dolomite) absorb more radiation emitted from the source than less dense material (i.e., shale). Porosity is also a contributing factor to the amount of back scatter emitted from the formation. In unconsolidated formations, highly porous deposits consisting of a clean, coarse gravel generally absorb less radiation (a high cps rate) than less porous materials such as clay, silt and fine sand (a lower cps rate). Natural background gamma emissions from earth materials are generally insignificant and do not affect the log.

The density probe is decentralized in the borehole by a bow spring mounted to one side of the probe. The bow spring presses the probe against the side of the borehole wall making the logging run as consistent as possible. Since changes in borehole diameter (washouts, fractures, bedding planes, etc.) can affect the log considerably, a caliper log is generally necessary in open boreholes to aid in interpretation. The radius of investigation of the density probe is about 6 inches but may exceed this distance in some instances. ISGS density logs are graduated in Counts Per Second (CPS) and/or American Petroleum Institute (API) units (see scales on top of log).

4

Gamma Log

A natural gamma-ray log is a graph of the gross gamma radiation (high energy electromagnetic radiation) emitted by the earth materials surrounding the sonde. Most natural earth radiation is generated from isotopes of Potassium-40 and Uranium-238. In Illinois, these elements are most abundant in clay minerals and less concentrated in clean quartz sand, gravel, and pure dolomite or limestone rock. Consequently, low CPS values on natural gamma logs normally indicate zones of porous and permeable earth materials in unconsolidated deposits. Fluid or air-filled, plastic or steel cased boreholes generally have limited effect on levels of radiation detected by the sodium iodide crystal in the gamma sonde. The radius of detection is generally about 6 inches but may exceed this distance in some instances. ISGS natural gamma logs are graduated in CPS and/or API values. API values can be related to oil field borehole logs.

The chief use of the gamma log is for stratigraphic correlation and identification of lithology. Detrital sediments with fine-grained textures such as shale, buried soil zones and silty lake clay normally have the highest gamma intensity. The correlation between natural gamma log configurations and particle size analysis of Illinois earth materials is well established.

Neutron Log

The neutron log is potentially one of the most useful logs in hydrogeologic investigations because most of the sonde response is due to hydrogen concentration in and around the borehole. The ISGS sonde uses a 3.0-curie Americium-241/Beryllium(AM/Be) source, that has a flux of 6.67×10^6 neutrons per second. The AM/Be source is screwed onto the bottom of the probe. Approximately 1.2 feet above the source is the Helium-3 tube which is used to detect the influx of epithermal neutron (o.l to 100 electron volts) originating as fast neutron (more than 100,000 electron volts) from the Am/Be source. Initially, neutrons are emitted in the form of fast neutrons from the source and are eventually slowed down, becoming epithermal neutrons of thermal neutrons, or, in other words, are captured by hydrogen as in H_2O. Hydrogen is the most effective element in slowing down and capering neutrons because its nucleus has nearly the same mass as a neutron. Because the flux of the neutrons is inversely proportional to the amount of hydrogen present, and most of the hydrogen present is in water, the flux is inversely proportional to the amount of water. In other words, when water fills interstitial pore space, the neutron log records relative amounts of rock porosity with porosity increasing and CPS decreasing to the left side of the log or with porosity decreasing and CPS increasing to the right side of the log.

A neutron log cannot discriminate between hydrogen water associated with the porosity in a formation and hydrogen in bound water associated with hydroxyl ions (OH) found in clay minerals, are primary constituents of shales. As a result, shale, clays and other lithologies containing minerals with hydrogen, such as coal, have log departures that resemble high porosity on neutron logs. It is necessary to run a natural gamma log to determine clay mineral content for correcting false high moisture anomalies associated with clay and shale on neutron logs. The neutron logs of sandstone, limestone, and dolomite with very low clay mineral content are good indicators of relative porosity. Scale and departure on ISGS neutron logs compared favorably with Schlumberger Well Service (a world-wide borehole logging company) log from the Chicago area. The radius of investigation of the neutron probe is about 12 inches but may exceed this distance in some instances. ISGS logs can be graduated in both CPS and/or API values.

LOGGING RESULTS

Observation Wells 1 and 2. Section 34. T. 8 N.. R. 9 E.. Jasper County.

Observation (ob) well 1 is situated about S 970', E 1020' from the NW/c Section 34, T. 8 N., R. 9 S., and 190' northwest of production well no. 2. With respect to the other production wells, well no. 2 is located 520' northwest of well no. 3 and 510' northeast of well no. 1 in the E. J. Water Corporation well field. Observation well no. 1 is constructed with a 4-inch plastic casing to a depth of 40 or more feet. The gamma log on observation well no. 1 had a range of 60-160 cps (counts per second) and extended from the surface to about 35 feet. The density log had a range of 252-290 cps and extended from the water surface in the well (about 13 feet below land surface) to approximately 40 feet. The neutron log had a range of 120-147 cps and extended from about 15 to about 40 feet. The gamma log indicated sandy silt and clay from 0-15 feet and clean sand and gravel with little clay or silt from 15-35 feet. The neutron and density log configurations from about 14-40 feet indicated a uniform sand and gravel sequence with a good moisture content range between 125-145 cps. The density of the sand and gravel layers generally decreased below 30 feet as the count rate increased from a bout 250-670 cps to 270-290 cps.

Observation well 2 is constructed with a 4-inch plastic casing and is situated about S 1385', E 880' from NW/c Section 34, T. 8 N., R. 9 E., and 415' east of production well no. 1. The gamma log had a range of 57-180 cps and extended from the surface to 48 feet. The density log had a range from 258-302 cps and extended from 19-46 feet. The neutron log extended from the water level at 14.6 feet to 52 feet and had a range of 120-145 cps. The gamma

indicated sandy, silty, clay from the surface to 17 feet and sand and gravel with little clay or silt and a low favorable cps rate from 17-48 feet. Particle size data from mud rotary samples collected at 5-foot sample intervals from ob well no. 1 were statistically compared with the resistivity values from nearby station 56 and the gamma cps from observation well 2. Comparison of the grain sizes at 8 intervals from 5-40 feet from ob well no. 1 and resistivity values from nearby station no. 56 resulted in a linear correlation coefficient of r = 0.77750. Comparison of the silt and clay percentages from well no. 1 with the gamma radiation at nearby observation well no. 2 at the same 7 depth intervals gave a favorable linear correlation coefficient of r^2 = 0.88533. The correlation coefficients help to establish the reliability and accuracy of the results of the resistivity survey by comparing grain size with apparent resistivity values and, grain size with moisture content (neutron log) and bulk density. Both neutron and density logs can be used to help determine relative porosity (grain size) within a thick sequence of sand and gravel and corrected by the gamma log for silt and clay content.

The neutron logs of both ob wells indicate a general uniformity throughout the sand and gravel sequence. In ob well 2, the neutron and density logs indicate a drop in moisture content and an increase in density from 45-52 feet, suggesting a transition to finer sands and gravels. The overall homogeneity of the earth materials in this deposit as indicated by the logs, sieve analysis and resistivity soundings as compared to the well field's overall high productivity will help in comparing future surveys at other test sites.

Loveford - Test Site No. 4 - Section 10. T. 7 N., R. 9 E.. Jasper County.

Test site no. 4 is situated about S 1400', W 2750' NE/c Section 10, T. 7 N., R. 9 E., on the south side of an E-W road. The log at the site was run in a 2-inch ID steel casing. The gamma log extended from the surface to 42 feet and had a range of 43-145 cps. The density log configuration extended from the surface to 47 feet and had a range of 58-110 cps. The neutron log extended from the surface to 42 feet and had a range of 238-305 cps. The higher cps rates for the density and lower cps rates for the neutron logs is attributed to the smaller (2-inch) steel casing versus a larger (4-inch) plastic casing of the well field observation wells. The density increases (cps decreases) in the 2 inch steel wells because the formation is closer to the probe and there is less water-filled annular space in the casing as compared with the 4 inch casing.

The geophysical logs of Loveford T.H. no.4 correlated well with Speth's log from 0 - 15 feet. The gamma log indicated a clayey soil from 0 - 6 feet with the highest clay content at approximately 3 feet and a gradual transition from a clayey soil to sand from 6-12 feet. The remainder of the formation was clean sand and gravel as indicated by the gamma log and Speth's log.

The neutron and density logs were used to help determine relative porosity and grain size distribution within the sand and gravel formation between 12.0 and 47.0 feet. The hachure marks were filled in where the log configurations crossed, indicating a relative increase in porosity within the sand and gravel deposit. Hachures shown in the upper clay are irrelevant (refer to Neutron description for explanation) for interpretation of the sand and gravel characteristics and are corrected for clay content by the gamma log. There was considerable contrast between two depth intervals that indicated a probable change associated with grain size and porosity. From 17.0 - 28.0 feet, the neutron log shifts to the right (increasing count rate), indicating a decrease in hydrogen content as compared to the interval from 28.0 - 43.0 feet. This suggests that the percent porosity from 17.0 - 28.0 feet is lower than the percent porosity from 28.0 - 43.0 feet. The density log shifts in the opposite direction of the neutron log, confirming the difference in porosity between these two depth intervals.

In summary, the depth interval from 15.0 - 43.0 feet is a clean sand and gravel deposit as indicated by the gamma log and driller's log. The depth interval from 17.0 - 28.0 feet appears to consist of finer-grained sand and/or gravel than the lower 28.0 - 43.0 foot depth interval, as indicated by the neutron and density logs. The large departures on the density and neutron logs at 17-28 feet were not depicted on any of the other test holes logged indicating a change in lithology (as compared to the observation and Rafetown test holes) within this portion of the formation at the Loveford site.

Rafetown - Test Site No. 3 - Section 20, T. 5 N.. R. 14 W.. Jasper County

Test Site No. 3 is situated about N 2550', W 2000' from the SE/c Section 20, T. 5 N., R. 14 W., on the south side of an E-W road. The logs at this site were run in a 2-inch steel casing. The gamma log extended from the surface to 50 feet and had a range of 67-130 cps. The slightly higher count rate at the upper end of the range suggests a concentration of clay in the formation. The density log extended from 2 feet below the surface to 54 feet and had a count rate of 75-98 cps below the water level at 6.2 feet which overall was less dense and therefore more favorable than the Loveford Test Hole #4 site which had a density range of 58-110 cps. The neutron configuration extended from the 6-54 feet range and had a range of 228-277 cps

and was considered more favorable than the Loveford Test Hole #4 site which had a neutron range of 238-305 cps.

The linear correlation coefficient for EER Station no. 56 at the well field and EER Station no. 92 near the Rafetown test no. 3 was $r^2 = 0.72110$ for 11 paired values. The comparative correlation values indicated that test no. 3 was favorable for testing of high capacity well development.

The gamma log indicated clay from the surface with a gradual transition to clean sand and/or gravel from approximately 13 -15 feet. From 15 - 50 feet, the gamma log indicated clean sand and gravel. The geophysical logs for the Rafetown test hole correlated well with the driller's log and by all accounts shows to be an ideal sight for pump testing. Both the density and neutron logs indicated a general increase in porosity from 25-50 feet (shown by the hachures), which correlated with the driller's log. The depth interval from 13.0 - 25.0 feet indicates a lower porosity than from 25-50 feet. Both depth intervals correlate very well with the nuclear logs and the driller's log in depicting particle grain size.

CONCLUSION

The purpose of this report on the results of the test drilling and the borehole geophysical logging of the ob wells of the original well field and the test holes of the Loveford and Rafetown was to establish a basis of reference for present and future testing and expansion in the Embarass River Valley by locating optimum sites for test drilling. The resistivity survey, when combined with the driller's logs helped to establish boundaries and extent of the sand and gravel deposits and depths to bedrock in most instances. The drilling results and borehole logs were helpful in confirming resistivity soundings reflecting deposits with coarser grained earth materials (clay/silt vs. sand/gravel) and in establishing bedrock elevations.

The geophysical logs of the observation wells at the existing well field were compared with laboratory sieve analysis of the rotary samples collected at the time the observation wells were drilled in order to establish a relationship between particle grain size and the departures on the density and neutron log configurations. By comparing grain size analysis of the samples collected at ob well no. 1 with the neutron and density logs, correlations were attempted between the observation wells and the Loveford and Rafetown test holes where samples were not collected. Relative grain size and porosity could not be correlated positively from the neutron and density logs between the ob wells and the Rafetown/Loveford wells because of the difference in drilling methods (rotary vs. auger), casing type and size and the reliability

of sieve analysis using rotary samples. Actual percent porosity cannot be determined with the logs alone, but relative porosity throughout a sand and gravel deposit within a single well can be. If drilling and well construction techniques are consistent for each test hole, then correlations can be made on relative porosity from site to site. Correlations were made between the Rafetown and Loveford sites because drilling and well construction parameters were the same. The solid stem augering method and the 2 inch driven sand points proved to be very effective in obtaining borehole logs representative of particle size (as compared to the driller's log) within the sands and gravels. By not collecting samples (preferably split spoon, continuously or every 2 feet) at Loveford and Rafetown, establishing a relationship between particle size and nuclear log departures cannot be established. Drilling methods, casing type and installation procedures should remain consistent for correlation. In future projects, collecting at least one continuous core should be considered at a favorable resistivity station for more accurate correlation with resistivity soundings and borehole logs.

Please refer to our report dated December 2, 1994 entitled "A Supplemental Electrical Earth Resistivity Survey For The E. J. Water Corporation, Section 3, 10, 11, 14 and 15, T. 7 N., R. 9 E., Jasper County, Illinois." The results of the 1995 test drilling at 11 sites by Speth Incorporated indicated that higher bedrock elevations are present west and south of test holes nos. 4 - 6 which are situated west and south of station 149 in alignment 2. We thought that the driller Speth did a good job in delineating the bedrock surface along alignment 2. The bedrock high and lower permeability materials were encountered west of station 185 in alignment 3 also. To the north in alignment no. 1, resistivity values east of station no. 165 (nos. 166-173) appear to have the most potential for groundwater development. With respect to our suggested locations in alignments 4, we were disappointed that the depth to bedrock was between 40-47 feet below land surface as indicated on the driller's log and would anticipate that deeper tests would be present in the vicinity of station nos. 198-204 in alignment no. 5.

We suggest additional test drilling be performed east of Loveford test hole no. 4 at station nos. 158, 160 and 161 within alignment no. 2, and at station nos. 198, 199 and 204 within alignment no. 5 of the Loveford test area. Drilling should be performed at or as close to the suggested locations as possible. Wells should be installed at locations that show an increase in depth to bedrock and in thickness of coarse grained sand and gravel above what was encountered in the existing well no. 4. We do not expect bedrock depths

to have substantial changes at stations nos. 158, 160 and 161 but grain size and thickness may be. Alignment no. 5 may be more promising in relation to depth of bedrock. Thicker, coarser grained deposits also appear more favorable.

With this report and additional test drilling we will have a better understanding of the nature and extent of the deposits in the Loveford and Rafetown test sites to better serve the needs and requirements of the E. J. Water Corporation and consequently the people of Illinois. This report will serve as a basis for better understanding and identifying future potential well sites through combined surface and borehole geophysics. We apologize for any delays in preparing this report and thank you for your cooperation and patience and look forward to future projects.

Logging.rpt

GEOPHYSICAL LOG
ILLINOIS STATE GEOLOGICAL SURVEY
CHAMPAIGN, ILLINOIS

Wellname: EJOBW1
Filename: C:\ILWSGSLOGS\EJWATER\EJWDOB01.HDR
Log Type: NATURAL GAMMA, DENSITY, AND NEUTRON
County: JASPER

Location: SW 1/4, NE 1/4, NW 1/4, SEC 34, T5N, R9E.
Legal Description: SW 1/4, NE 1/4, NW 1/4, SEC. 34, T5N, R9E.
Physical Description: 220' E AND 355 N OF THE SWC OF THE NE 1/4, SEC 34.

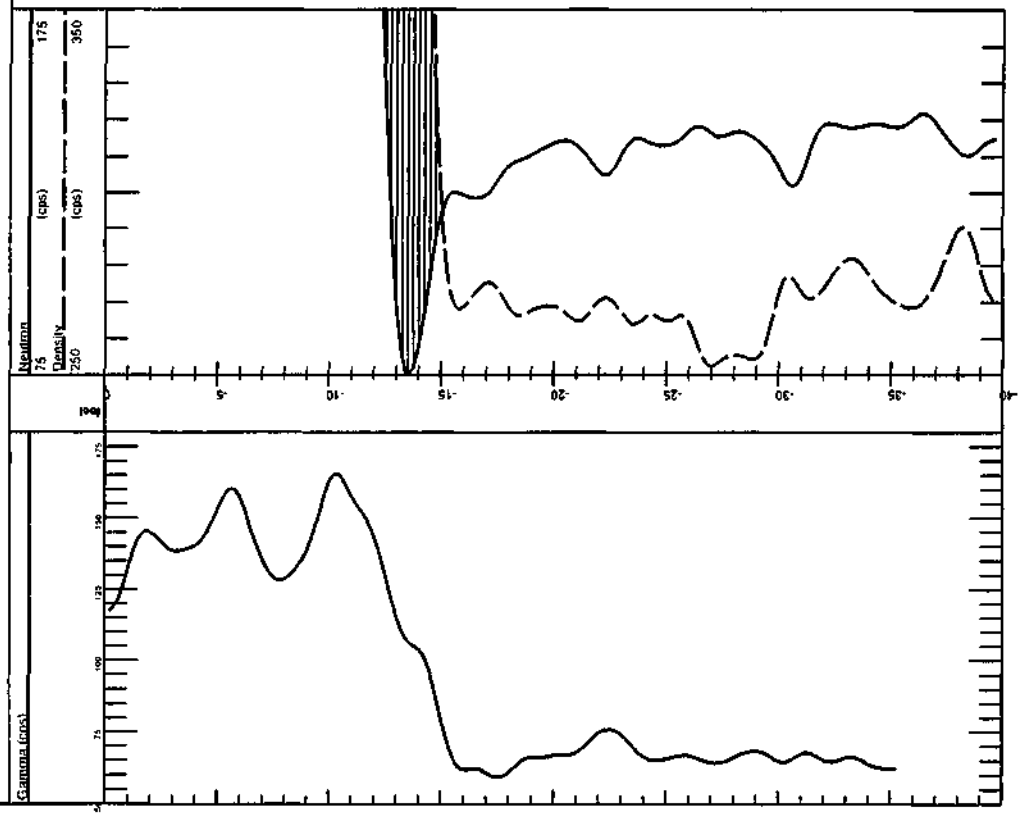
Elevation: 0 Reference: Ground Surface
OWNER, COMPANY: EJ WATER CORPORATION
WELL OR TEST: EJOBW01
CONTRACTOR/DRILLER: H & H DRILLING CO./TIM HACKER
LOG MEA. FROM (KB, DF, or GL): GL
ELEVATION, SOURCE, AND QUAD: 490 FEET MSL, 7.5' TOPO, ROSE HILL 1985
LOG SEQUENCE: 1.GAMMA RAY/NEUTRON, 2.DENSITY.
DATE DRILLED:
DATE LOGGED: JULY 14, 1995 AND FEBRUARY 16, 1996.
FIRST READING: GAMMA AT 0.2 FT BGS, NEUTRON AT 4.4 FT BGS, DENS. AT 5.0 FT BGS.
LAST READING: GAM AT 35.3', NEUT AT 39.7', DENS AT 39.7'.
FOOTAGE LOGGED: GAM-35.1 FT. NEUT.-35.3 FT. DENS-36.7 FT.
BOTTOM (Driller/Log): UNKNOWN/APPROX. 41.2 FEET INSIDE PVC
CASING TYPE & SIZE: 4 IN. PVC
CASING INTERVAL (Driller/Log): UNKNOWN/ +2.7 FT., -41.2 FT.
SCREENED INTERVAL: UNKNOWN
BIT TYPE & SIZE:UNKNOWN
HOLE FLUID TYPE: FORMATION
DENSITY:
VISCOSITY:
PH:
RESISTIVITY:
RES. @ BHT:
CIRC. TEMP:
B.H. TEMP:
SPECIFIC COND.:
LEVEL: 15.7 BELOW TOP OF CASING OR 13.0 FEET BGS.
LOGGED BY: YOUNG AND REED
WITNESSED BY: DAN MAHAFFEY AND DAVE KLITZING

Gamma (cps)
Converted from file: EJWTROB1
Logging direction: Upwards

Neutron (cps)
Converted from file: EJWTROB1
Logging direction: Upwards

Density (cps)
Converted from file: EJOBTDEN
Logging direction: Upwards

Comments:



GEOPHYSICAL LOG
ILLINOIS STATE GEOLOGICAL SURVEY
CHAMPAIGN, ILLINOIS

Wellname: EJOBW2
Filename: C:\WL\WBGBLOGS\EJWATER\EJOB2.NOR
Log Type: NATURAL GAMMA, DENSITY, AND NEUTRON
County: JASPER

Location
Legal Description: NWPD, SE 1/4, NW 1/4, SEC. 34, T8N, R9E
Physical Description: S 870', E 1620', FROM NW/C SEC 34, T8N, R9E.

Elevation 0 Reference Ground Surface
OWNER, COMPANY: EJ WATER CORPORATION
WELL OR TEST: EJOBW2
CONTRACTOR/DRILLER: H & H DRILLING CO./TIM HACKER
LOG MEA. FROM (KB, DF, or GL): GL

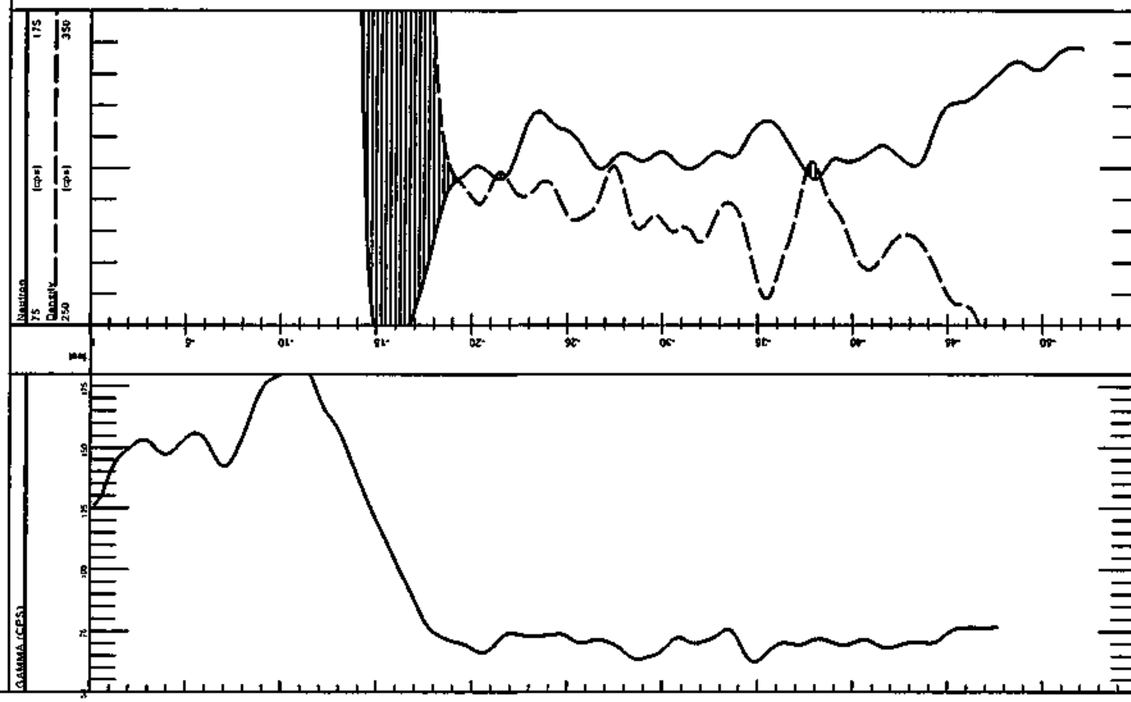
ELEVATION, SOURCE, AND QUAD: 497.5 FEET MSL, 7.5' TOPO, ROSEHILL 1968.
LOG SEQUENCE: 1.GAMMA RAY-NEUTRON, 2.DENSITY.
DATE DRILLED: NOT KNOWN
DATE LOGGED: JULY 14, 1998 AND FEBRUARY 19, 1999
FIRST READING: GAMMA AT -47.7 FT., NEUTRON AT -47.1 FT., DENSITY AT -41.7 FT.
LAST READING: GAMMA AT -0.2 FT, NEUTRON AT -4.9 FT, DENSITY AT -3.0 FT.
FOOTAGE LOGGED: GAMMA-47.5 FT, NEUTRON-47.5 FT, DENSITY-48.7 FT.
BOTTOM (Driller/Log): UNKNOWN/APPROX. 48.5 FT INSIDE PVC.
CASING TYPE & SIZE: 4 IN. PVC
CASING INTERVAL (Driller/Log): UNKNOWN/ +2.7 FT TO -43.2 FT
DENSITY: ________
VISCOSITY: ________
PH: ________
RESISTIVITY: ________
RES. @ BHT: ________
CIRC. TEMP: ________
B.H. TEMP: ________
SPECIFIC COND: ________
HOLE FLUID TYPE: FORMATION
LEVEL: 17.3 FT BELOW TOP OF CASING OR 14.6 BGS
LOGGED BY: YOUNG AND REED
WITNESSED BY: DAN MAHAFFEY AND DAVE KLITZING

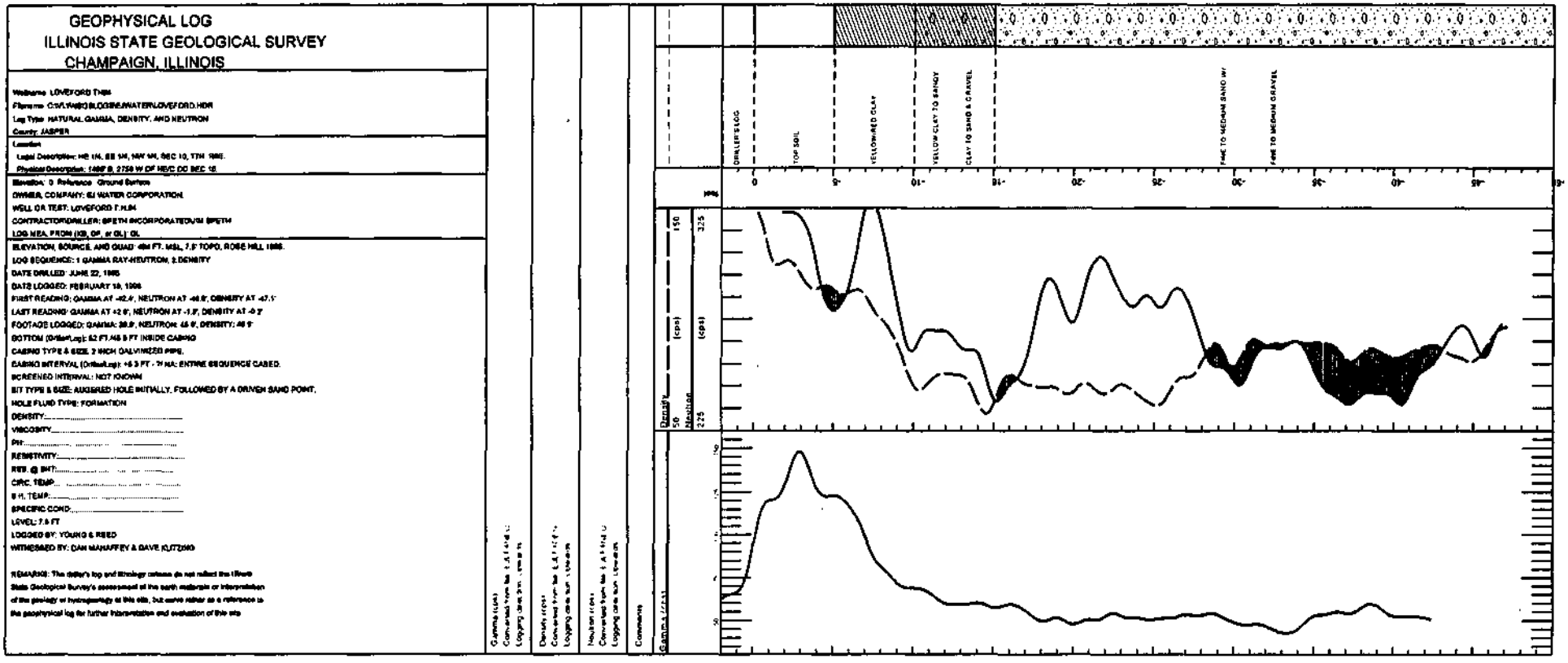
GAMMA (CPS)
Converted from file: EJOB2NEU
Logging direction: Upwards

Neutron (cps)
Converted from file: EJOB2NEU
Logging direction: Upwards

Density (cps)
Converted from file: EJOB2DEN
Logging direction: Upwards

Comments:




GEOPHYSICAL LOG
ILLINOIS STATE GEOLOGICAL SURVEY
CHAMPAIGN, ILLINOIS
Wellname: LOVEFORD THIS
Filename: C:\FLYWIN\BLOGS\NEWWATER\LOVEFORD.HDR
Log Type: NATURAL GAMMA, DENSITY, AND NEUTRON
County: JASPER
Location
Legal Description: NE 1/4, SE 1/4, NW 1/4, SEC 10, T7N R8E.
Physical Description: 1466' S, 2750 W OF NE/C OC SEC 10
Elevation: 0 Reference: Ground Surface
OWNER, COMPANY: GJ WATER CORPORATION
WELL OR TEST: LOVEFORD T.H.04
CONTRACTOR/DRILLER: SPETH INCORPORATED/JIM SPETH
LOG MEA. FROM (KB, DF, or GL): GL
ELEVATION, SOURCE, AND QUAD: 494 FT. MSL, 7.5' TOPO, ROSE HILL 1986.
LOG SEQUENCE: 1 GAMMA RAY-NEUTRON, 2 DENSITY
DATE DRILLED: JUNE 22, 1995
DATE LOGGED: FEBRUARY 16, 1996
FIRST READING: GAMMA AT -62.4', NEUTRON AT -46.8', DENSITY AT -47.1'
LAST READING: GAMMA AT +2.6', NEUTRON AT -1.8', DENSITY AT -0.2'
FOOTAGE LOGGED: GAMMA: 65.9', NEUTRON: 48.6', DENSITY: 48.9'
BOTTOM (DrillersLog): 52 FT./48.5 FT INSIDE CASING
CASING TYPE & SIZE: 2 INCH GALVANIZED PIPE.
CASING INTERVAL (DrillersLog): +0.3 FT - 7' NA: ENTIRE SEQUENCE CASED.
SCREENED INTERVAL: NOT KNOWN
BIT TYPE & SIZE: AUGERED HOLE INITIALLY, FOLLOWED BY A DRIVEN SAND POINT.
HOLE FLUID TYPE: FORMATION
DENSITY:
VISCOSITY:
PH:
RESISTIVITY:
RES. @ BHT:
CIRC. TEMP.:
B.H. TEMP.:
SPECIFIC COND.:
LEVEL: 7.5 FT
LOGGED BY: YOUNG & REED
WITNESSED BY: DAN MANAFFEY & DAVE KUTZKO
REMARKS: The driller's log and lithology column do not reflect the Illinois State Geological Survey's assessment of the earth materials or interpretation of the geology or hydrogeology at this site, but serve rather as a reference to the geophysical log for further interpretation and evaluation of the site
Gamma (cps)
Converted from Ra-226 Equivalent
Logging data from Schlumberger
Density (cps)
Converted from Ra-226 Equivalent
Logging data from Schlumberger
Neutron (cps)
Converted from Ra-226 Equivalent
Logging data from Schlumberger
Comments
Gamma (cps)
Density (cps)
50
Neutron (cps)
225
150
325
DRILLER'S LOG
TOP SOIL
YELLOW/RED CLAY
YELLOW CLAY TO SANDY
CLAY TO SAND & GRAVEL
FINE TO MEDIUM SAND W/
FINE TO MEDIUM GRAVEL
FEET
0
-5
-10
-15
-20
-25
-30
-35
-40
-45
-50

GEOPHYSICAL LOG
ILLINOIS STATE GEOLOGICAL SURVEY
CHAMPAIGN, ILLINOIS

Wellname: RAFETOWN T.H.#5
Filename: C:\WLI\WELLOGS\EJWATER\RAFETOWN.HDR
Log Type: NATURAL GAMMA, NEUTRON AND DENSITY.
County: JASPER

Location
Legal Description: CASORTH LINE, NW 1/4, SE 1/4, SEC. 20, T8N, R14W
Physical Description: N 5555', W 2095', SEC SEC. 20.

Elevation: 0 Reference: Ground Surface
OWNER, COMPANY: EJ WATER CORPORATION
WELL OR TEST: RAFETOWN T.H.#5.
CONTRACTOR/DRILLER: SPETH INCORPORATED/MR SPETH
LOG MEA. FROM KB, DF, or GL: GL
ELEVATION: SOURCE, AND DIMS: APPROX.488 MSL, 7.5' TOPO, LANDS# 1988.
LOG SEQUENCE: 1.GAMMA RAY-NEUTRON 3 DENSITY
DATE DRILLED: FEBRUARY 1, 1988
DATE LOGGED: FEBRUARY 16, 1988
FIRST READING: GAMMA AT +1.6', NEUTRON AT -2.5', DENSITY AT -1.3'.
LAST READING: GAMMA AT 48.5', NEUTRON AT 59.5', DENSITY AT 53.7'.
FOOTAGE LOGGED: GAMMA 47.9', NEUTRON 61.1', DENSITY 53.5'.
BOTTOM (Driller/Logger 53.5'/53.3' Bridge Cable)
CASING TYPE & SIZE: 2.0 IN. GALVANIZED PIPE
CASING INTERVAL (Driller/Logger 4-4 STO -55.7'
SCREENED INTERVAL: NOT GIVEN
BIT TYPE & SIZE: INITIALLY AUGERED (SOLID STEM) THEN SAND POINT DRIVEN
MUD FLUID TYPE: FORMATION
DENSITY:
VISCOSITY:
PH:
RESISTIVITY:
BED. @ BHT.
CIRC. TEMP:
B.H. TEMP:
SPECIFIC COND:
LEVEL: 0.2 BGS
LOGGED BY: YOUNG & REED
WITNESSED BY: DAN MAHAFFEY & DAVE RUTZMO

REMARKS: The driller's log and lithology column do not reflect the Illinois State Geological Survey's assessment of the earth materials or interpretation of the geologic or hydrogeology at this site, but serve rather as a reference to the geophysical log for further interpretation and evaluation of this site.

Gamma (cps)
Corrected from file: EARTHEU
Logging equation: Uranium

Neutron (cps)
Corrected from file: EARTHEU
Logging equation: Uranium

Density (cps)
Corrected from file: EARTHDEN
Logging equation: Uranium

Comments:

Appendix A. Test Boring Logs at Well Field Site

Test Boring No.:	1
Site:	Embarras River Valley
Drilling Contractor:	Speth Plumbing, Inc.
Date Drilled:	June 22, 1995
Drilling Method:	Solid auger
Depth:	48 feet
Hole Record:	5-inch; 0-48 feet
Casing Record:	None
Screen Record:	None
Ground Elevation:	493 feet above mean sea level (msl), topographic map
Location:	Approximately 1250 feet West and 30 feet North of the SE corner, Section 10, T.7 N., R.9 E., Jasper County
Remarks:	

DRILLERS LOG

Formation	From *(feet)*	To *(feet)*
Sandy clay	0	5
Sand	5	10
Soupy sand	10	15
Tight gray sand w/mud mix	15	47
Shale	47	48

Appendix A. Continued

Test Boring No.:	2
Site:	Embarras River Valley
Drilling Contractor:	Speth Plumbing, Inc.
Date Drilled:	June 22, 1995
Drilling Method:	Solid auger
Depth:	35 feet
Hole Record:	5-inch; 0-35 feet
Casing Record:	None
Screen Record:	None
Ground Elevation:	492 feet above mean sea level (msl), topographic map
Location:	Approximately 2650 feet East and 30 feet North of the SW corner, Section 10, T.7 N., R.9 E., Jasper County

Remarks:

DRILLERS LOG

Formation	From *(feet)*	To *(feet)*
Sandy clay	0	5
Sand	5	10
Soupy sand	10	15
Tight gray sand w/ mud mix	15	46
Shale	46	47

Appendix A. Continued

Test Boring No.:	3
Site:	Embarras River Valley
Drilling Contractor:	Speth Plumbing, Inc.
Date Drilled:	June 22, 1995
Drilling Method:	Solid auger
Depth:	40 feet
Hole Record:	5-inch; 0-40 feet
Casing Record:	None
Screen Record:	None
Ground Elevation:	493 feet above mean sea level (msl), topographic map
Location:	Approximately 1400 feet East and 30 feet North of the SW corner, Section 10, T.7 N., R.9 E., Jasper County

Remarks:

DRILLERS LOG

Formation	From *(feet)*	To *(feet)*
Sandy clay	0	5
Sand	5	10
Soupy sand	10	15
Tight gray sand w/ mud mix	15	39
Shale	39	40

Appendix A. Continued

Test Boring No.:	4
Site:	Embarras River Valley
Drilling Contractor:	Speth Plumbing, Inc.
Date Drilled:	June 22, 1995
Drilling Method:	Solid auger
Depth:	51.5 feet
Hole Record:	5-inch; 0-51.5 feet
Casing Record:	2-inch galvanized pipe, +5.3-47.5 feet
Screen Record:	2-inch galvanized sand point, 47.5-51.5 feet, 60 gauze openings, 3 feet long
Ground Elevation:	493 feet above mean sea level (msl), topographic map
Location:	Approximately 2725 feet East and 1350 feet South of the NW corner, Section 10, T.7 N, R.9 E., Jasper County

Remarks:

DRILLERS LOG

Formation	From *(feet)*	To *(feet)*
Sandy clay	0	15
Coarse sand	15	22
Coarse sand and fine gravel mix	22	51
Shale	51	52

Appendix A. Continued

Test Boring No.:	5
Site:	Embarras River Valley
Drilling Contractor:	Speth Plumbing, Inc.
Date Drilled:	June 22, 1995
Drilling Method:	Solid auger
Depth:	51 feet
Hole Record:	5-inch; 0-51 feet
Casing Record:	None
Screen Record:	None
Ground Elevation:	492 feet above mean sea level (msl), topographic map
Location:	Approximately 2050 feet East and 1350 feet South of the NW corner, Section 10, T.7 N., R.9 E., Jasper County

Remarks:

DRILLERS LOG

Formation	From *(feet)*	To *(feet)*
Sandy clay	0	18
Coarse sand	18	22
Coarse sand and fine gravel mix	22	50
Shale	50	51

Appendix A. Continued

Test Boring No.:	6
Site:	Embarras River Valley
Drilling Contractor:	Speth Plumbing, Inc.
Date Drilled:	June 22, 1995
Drilling Method:	Solid auger
Depth:	53 feet
Hole Record:	5-inch; 0-53 feet
Casing Record:	None
Screen Record:	None
Ground Elevation:	492 feet above mean sea level (msl), topographic map
Location:	Approximately 2300 feet East and 1700 feet South of the NW corner, Section 10, T.7 N., R.9 E., Jasper County

Remarks:

DRILLERS LOG

Formation	From *(feet)*	To *(feet)*
Sandy clay	0	18
Coarse sand	18	23
Coarse sand and fine gravel mix	23	52
Shale	52	53

Appendix A. Continued

Test Boring No.:	7
Site:	Embarras River Valley
Drilling Contractor:	Speth Plumbing, Inc.
Date Drilled:	November 22, 1995
Drilling Method:	Solid auger
Depth:	53 feet
Hole Record:	5-inch; 0-53 feet
Casing Record:	None
Screen Record:	None
Ground Elevation:	491 feet above mean sea level (msl), topographic map
Location:	Approximately 1300 feet West and 1250 feet South of the NE corner, Section 10, T.7 N., R.9 E., Jasper County

Remarks:

DRILLERS LOG

Formation	From *(feet)*	To *(feet)*
Sandy clay	0	20
Fine sand	20	25
Fine sand and some gravel mix	25	52
Shale	52	53

Appendix A. Continued

Test Boring No.:	8
Site:	Embarras River Valley
Drilling Contractor:	Speth Plumbing, Inc.
Date Drilled:	November 22, 1995
Drilling Method:	Solid auger
Depth:	54 feet
Hole Record:	5-inch; 0-54 feet
Casing Record:	None
Screen Record:	None
Ground Elevation:	493 feet above mean sea level (msl), topographic map
Location:	Approximately 1850 feet West and 1250 feet South of the NE corner, Section 10, T.7 N., R.9 E., Jasper County

Remarks:

DRILLERS LOG

Formation	From *(feet)*	To *(feet)*
Sandy clay	0	18
Fine sand	18	25
Fine to coarse sand mix (soupy)	25	53
Shale	53	54

Appendix A. Continued

Test Boring No.:	9
Site:	Embarras River Valley
Drilling Contractor:	Speth Plumbing, Inc.
Date Drilled:	November 22, 1995
Drilling Method:	Solid auger
Depth:	40 feet
Hole Record:	5-inch; 0-40 feet
Casing Record:	None
Screen Record:	None
Ground Elevation:	493 feet above mean sea level (msl), topographic map
Location:	Approximately 2600 feet West and 900 feet South of the NE corner, Section 10, T.7 N., R.9 E., Jasper County

Remarks:

DRILLERS LOG

Formation	From *(feet)*	To *(feet)*
Sandy clay	0	20
Fine sand	22	26
Sand (tight auguring)	26	40
Stopped auguring but not sure if it was the end of the material		

Appendix A. Continued

Test Boring No.:	10
Site:	Embarras River Valley
Drilling Contractor:	Speth Plumbing, Inc.
Date Drilled:	November 22, 1995
Drilling Method:	Solid auger
Depth:	53 feet
Hole Record:	5-inch; 0-53 feet
Casing Record:	None
Screen Record:	None
Ground Elevation:	492 feet above mean sea level (msl), topographic map
Location:	Approximately 2700 feet East and 2000 feet South of the NW corner, Section 10, T.7 N., R.9 E., Jasper County

Remarks:

DRILLERS LOG

Formation	From *(feet)*	To *(feet)*
Sandy clay	0	15
Coarse sand	15	20
Coarse sand and fine gravel mix	20	43
Shale	43	44

Appendix A. Continued

Test Boring No.:	11
Site:	Embarras River Valley
Drilling Contractor:	Speth Plumbing, Inc.
Date Drilled:	November 22, 1995
Drilling Method:	Solid auger
Depth:	46 feet
Hole Record:	5-inch; 0-46 feet
Casing Record:	None
Screen Record:	None
Ground Elevation:	492 feet above mean sea level (msl), topographic map
Location:	Approximately 1750 feet East and 1350 feet South of the NW corner, Section 10, T.7 N., R.9 E., Jasper County

Remarks:

DRILLERS LOG

Formation	From *(feet)*	To *(feet)*
Sandy clay	0	15
Coarse sand	15	23
Coarse sand and fine gravel mix	23	45
Shale	45	46

Appendix A. Continued

Test Boring No.:	12
Site:	Embarras River Valley
Drilling Contractor:	Speth Plumbing, Inc.
Date Drilled:	May 23, 1996
Drilling Method:	Solid auger
Depth:	49 feet
Hole Record:	5-inch; 0-49 feet
Casing Record:	None
Screen Record:	None
Ground Elevation:	493 feet above mean sea level (msl), topographic map
Location:	Approximately 1350 feet West and 650 feet North of the SE corner, Section 3, T.7 N., R.9 E., Jasper County

Remarks:

DRILLERS LOG

Formation	From *(feet)*	To *(feet)*
Dark top soil	0	5
Muddy brown clay	5	15
Soupy brown mud, some quick sand	15	20
Fine to medium sand	20	30
Coarse sand and fine to medium gravel mix	30	48½
Shale 48½		49

Appendix A. Continued

Test Boring No.:	13
Site:	Embarras River Valley
Drilling Contractor:	Speth Plumbing, Inc.
Date Drilled:	May 23, 1996
Drilling Method:	Solid Auger
Depth:	46½ feet
Hole Record:	5-inch; 0-46½ feet
Casing Record:	None
Screen Record:	None
Ground Elevation:	492 feet above mean sea level (msl), topographic map
Location:	Approximately 2200 feet West and 30 feet South of the NE corner, Section 10, T.7 N., R.9 E., Jasper County

Remarks:

DRILLERS LOG

Formation	From *(feet)*	To *(feet)*
Dark clay top soil	0	5
Wet brown sand	5	10
Fine to medium brown sand	10	15
Fine to coarse sand	15	18
Coarse sand and fine gravel mix	18	30
Mud streak, gray	30	32
Coarse sand and fine gravel mix	32	46
Shale	46	46Vi

Appendix A. Continued

Test Boring No.:	14
Site:	Embarras River Valley
Drilling Contractor:	Speth Plumbing, Inc.
Date Drilled:	May 23, 1996
Drilling Method:	Solid auger
Depth:	50½ feet
Hole Record:	5-inch; 0-50V2 feet
Casing Record:	None
Screen Record:	None
Ground Elevation:	492 feet above mean sea level (msl), topographic map
Location:	Approximately 2250 feet West and 550 feet North of the SE corner, Section 3, T.7 N., R.9 E., Jasper County

Remarks:

DRILLERS LOG

Formation	From *(feet)*	To *(feet)*
Dark brown clay	0	5
Red brown clay	5	9
Fine sand, soupy	9	20
Coarse sand, some fine gravel	20	30
Mud streak with layers of sand and gravel	30	40
Coarse sand and fine to medium gravel mix	40	50
Shale	50	50½

Appendix A. Continued

Test Boring No.:	15
Site:	Embarras River Valley
Drilling Contractor:	Speth Plumbing, Inc.
Date Drilled:	May 23, 1996
Drilling Method:	Solid auger
Depth:	35 feet
Hole Record:	5-inch; 0-35 feet
Casing Record:	None
Screen Record:	None
Ground Elevation:	492 feet above mean sea level (msl), topographic map
Location:	Approximately 50 feet East and 1300 feet South of the NW corner, Section 11, T.7 N., R.9 E., Jasper County

Remarks:

DRILLERS LOG

Formation	From *(feet)*	To *(feet)*
Dark brown top soil	0	5
Wet brown yellow clay	5	10
Quick sand	10	15
Fine to medium sand, some fine gravel	15	20
Coarse sand and fine gravel mix	20	35
Sand rock, white	35	

Appendix A. Concluded

Test Boring No.:	16
Site:	Embarras River Valley
Drilling Contractor:	Speth Plumbing, Inc.
Date Drilled:	May 23, 1996
Drilling Method:	Solid auger
Depth:	54½ feet
Hole Record:	5-inch; 0-54½ feet
Casing Record:	None
Screen Record:	None
Ground Elevation:	492 feet above mean sea level (msl), topographic map
Location:	Approximately 700 feet West and 1250 feet South of the NE corner, Section 10, T.7 N., R.9 E., Jasper County

Remarks:

DRILLERS LOG

Formation	From *(feet)*	To *(feet)*
Dark clay top soil	0	5
Wet brown clay	5	10
Soupy brown sandy clay	10	15
Quick sand	15	20
Fine to medium sand	20	25
Coarse sand, very little gravel, gray	25	54
Shale	54	54½

Appendix B.

Construction Information for Wells 11 and 12 and Observation Wells

AQUIFER TEST
E J WATER CORPORATION WELL 11, SOUTH WELL FIELD
JASPER COUNTY, ILLINOIS

by
Illinois State Water Survey
Speth Plumbing, Inc.
Trustees, E J Water Corporation

Well Owner:	E J Water Corporation
Site:	Embarras River Valley
Well Location:	Approximately 1370 feet South and 2700 feet East of the NW/corner, Section 10, T.7 N., R.9 E., Jasper County, Illinois
Date Well Completed:	September 30, 1996
Date of Step Test:	October 15, 1996
Length of Step Test:	5 30-minute steps
Date of 4-Day Aquifer Test:	October 17-21,1996
No. of Observation Wells:	4
Aquifer:	Sand and Gravel

PUMPED TEST WELL DATA

Well No.:	Well 11 (proposed)
Depth:	50 feet
Drilling Contractor:	Speth Plumbing, Inc., Allendale, IL
Formation Samples:	
Drilling Method:	Bucket
Hole Record:	32-inch, 0-51.5 feet
Casing Record:	12-inch steel, +0.8-35 feet
Screen Record:	12-inch stainless steel, 35-50 feet; 0.040-inch slot (40 slot), 15-feet long
Annulus and Gravel Pack Record:	Benseal, 10-25 feet; Northern Gravel Coarse No. 0,25-51.5 feet
Ground Elevation at Well:	Approximately 493 feet above mean sea level (msl), topographic map
Measuring Point:	Top of well casing (TOC), 0.8 feet above land surface (lsd)
Elevation Top of Well Casing:	

Nonpumping Water Level:	11.02 feet below TOC, 8:59 am, October 15, 1996 11.00 feet below TOC, 11:04 am, October 17, 1996 8.08 feet below TOC, 10:24 am, August 5, 1997
Measuring Equipment:	Steel tape, electric dropline, InSitu Hermit datalogger w/ pressure transmitters, SWS 4-inch orifice tube with plate 34
Test Pump and Power:	Submersible turbine w/ diesel generator
Test Pump Setting:	Approximately 48.5 feet
Time Water Samples Collected:	12:45 pm, October 15, 1996 5:00 pm, October 18, 1996
Temperature of Water:	56.3 ° F

TEST WELL
DRILLERS LOG
(Test Boring at site of Test Well)

Formation	From *(feet)*	To *(feet)*
Dark brown clay	0	5
Dark brown clay w/ sand mix from 8-10 feet	5	10
Coarse sand and fine gravel mix	10	20
Coarse sand and fine to medium gravel mix	20	30
Coarse sand and fine gravel mix	30	35
Medium to coarse sand some fine gravel	35	40
Medium to coarse sand very little gravel	40	45
Fine to medium sand	45	51
Gray shale	51	52

AQUIFER TEST
E J WATER CORPORATION WELL 12, SOUTH WELL FIELD
JASPER COUNTY, ILLINOIS

by
Illinois State Water Survey
Speth Plumbing, Inc.

Well Owner:	E J Water Corporation
Site:	Embarras River Valley
Well Location:	Approximately 890 feet South and 2745 feet East of the NW/corner, Section 10, T.7 N., R.9 E., Jasper County, Illinois
Date Well Completed:	July 28, 1997
Date of Step Test:	July 31,1997
Length of Step Test:	5 30-minute steps
Date of 24-Hour Aquifer Test:	August 5-6, 1997
No. of Observation Wells:	5 (incl PW 11)
Aquifer:	Sand and Gravel

PUMPED TEST WELL DATA

Well No.:	Well 12
Depth:	48 feet
Drilling Contractor:	Speth Plumbing, Inc., Allendale, IL
Formation Samples:	
Drilling Method:	Bucket
Hole Record:	32-inch, 0-50 feet
Casing Record:	12-inch steel, +1.2-38 feet
Screen Record:	12-inch PS 304 stainless steel, 38-48 feet; 0.080-inch slot (80 slot), 10-feet long
Annulus and Gravel Pack Record:	Cement -3-20; Benseal, 20-25 feet; Northern Gravel No. 3, 25-50 feet
Ground Elevation at Well:	Approximately 493 feet above mean sea level (msl), topographic map
Measuring Point:	Top of well casing (TOC), 1.2 feet above land surface (lsd)
Elevation Top of Well Casing:	

Nonpumping Water Level:	8.68 feet below TOC, 9:47 am, July 31, 1997
	9.03 feet below TOC, 10:29 am, August 5, 1997
Measuring Equipment:	Steel tape, electric dropline, InSitu Hermit datalogger w/ pressure transmitters, SWS 4-inch orifice tube with plate 35
Test Pump and Power:	Submersible turbine w/ diesel generator
Test Pump Setting:	Approximately 36.3 feet below TOC
Time Water Samples Collected:	2:50 pm, August 5, 1997
	11:20 am, August 6, 1997
Temperature of Water:	55.2 ° F
Remarks:	

TEST WELL
DRILLERS LOG

Formation	From *(feet)*	To *(feet)*
Top soil/yellow clay	0	5
Yellow clay	5	10
Yellow clay; sandy clay from 13 ft	10	15
Medium to coarse brown sand	15	20
Coarse brown sand, some fine gravel	20	25
Medium to coarse gray sand, some fine gravel	25	30
Fine to medium gray sand	30	40
Medium to coarse gray sand, very little gravel	40	48
Blue gray shale	48	50

WELL 12 PIEZOMETER

Piezometer No.:	1 (Installed in gravel pack between 12-inch casing/screen assembly and 32-inch borehole)
Site:	Embarras River Valley
Drilling Contractor:	Speth Plumbing, Inc.
Date Drilled:	July 28, 1997
Drilling Method:	na
Depth:	48 feet
Hole Record:	na
Casing Record:	2-inch PVC, +1.3-38 feet
Screen Record:	2-inch PVC; 10 slot; 38-48 feet
Annulus and Gravel Pack Record:	Cement -3-20; Benseal, 20-25 feet; Northern Gravel No. 3, 25-50 feet
Ground Elevation:	493 feet above mean sea level (msl), topographic map
Measuring Point:	Top of well casing (TOC), 1.3 feet above land surface (lsd)
Nonpumping Water Level:	9.09 feet below TOC, 10:30 am, August 5, 1997
Location:	Approximately 890 feet South and 2745 feet East of the NW/corner, Section 10, T.7 N., R.9 E., Jasper County, Illinois
Remarks:	Installed in annulus between well casing/screen assembly and borehole to facilitate future water level measurments.

DRILLERS LOG

Formation	From *(feet)*	To *(feet)*
Same as Well 12		

OBSERVATION WELL NO. 1 DATA

Observation Well No.:	1
Distance and Direction from Pumped Well 11:	92 feet South
Distance and Direction from Pumped Well 12:	556 feet South
Site:	Embarras River Valley
Drilling Contractor:	Speth Plumbing, Inc.
Date Drilled:	June 24, 1996
Drilling Method:	Straight rotary
Depth:	49 feet
Hole Record:	6-inch; 0-49 feet
Casing Record:	2-inch PVC, +3.0-32 feet
Screen Record:	2-inch PVC; sawed slots, 32-47 feet
Annulus and Gravel Pack Record:	Benseal, 0-20; gravel pack, 20-49
Ground Elevation:	494 feet above mean sea level (msl), topographic map
Measuring Point:	Top of well casing (TOC), 3.0 feet above land surface (lsd)
Nonpumping Water Level:	13.42 feet below TOC, 11:04 am, October 17, 1996 9.67 feet below TOC, 10:22 am, August 5, 1997
Location:	Approximately 1455 feet South and 2735 feet East of the NW/corner, Section 10, T.7 N., R.9 E., Jasper County, Illinois
Remarks:	

DRILLERS LOG

Formation	From *(feet)*	To *(feet)*
Dark brown clay	0	5
Dark brown clay, coarse sand and gravel @ 9 feet	5	10
Coarse sand and fine gravel mix	10	33
Medium to coarse gray sand, some fine gravel	33	35
Medium to coarse gray sand	35	42
Soft gray mud	42	45
Sand	45	46
Shale	46	49

OBSERVATION WELL NO. 2 DATA

Observation Well No.:	2
Distance and Direction from Pumped Well 11:	196 feet North
Distance and Direction from Pumped Well 12:	281 feet South
Site:	Embarras River Valley
Drilling Contractor:	Speth Plumbing, Inc.
Date Drilled:	June 25, 1996
Drilling Method:	Straight rotary
Depth:	51½ feet
Hole Record:	6-inch; 0-51½ feet
Casing Record:	2-inch PVC, +3.0-35 feet
Screen Record:	2-inch PVC; sawed slots, 35-50 feet
Annulus and Gravel Pack Record:	Benseal, 0-24 feet; gravel pack, 24-51½ feet
Ground Elevation:	493 feet above mean sea level (msl), topographic map
Measuring Point:	Top of well casing (TOC), 3.0 feet above land surface (lsd)
Nonpumping Water Level:	13.67 feet below TOC, 10:38 am, October 17, 1996 10.82 feet below TOC, 10:25 am, August 5, 1997
Location:	Approximately 1180 feet South and 2735 feet East of the NW/corner, Section 10, T.7 N., R.9 E., Jasper County. Illinois
Remarks:	

DRILLERS LOG

Formation	From *(feet)*	To *(feet)*
Dark brown clay	0	8
Sand	8	10
Coarse sand and fine gravel mix	10	20
Coarse sand and fine to medium gravel mix	20	40
Medium to coarse sand, very little gravel	40	51
Shale	51	51½

OBSERVATION WELL NO. 3 DATA

Observation Well No.:	3
Distance and Direction from Pumped Well 11:	496 feet North
Distance and Direction from Pumped Well 12:	24 feet Northwest
Site:	Embarras River Valley
Drilling Contractor:	Speth Plumbing, Inc.
Date Drilled:	June 25, 1996
Drilling Method:	Straight rotary
Depth:	51 feet
Hole Record:	6-inch; 0-51 feet
Casing Record:	2-inch PVC, +3.0-35 feet
Screen Record:	2-inch PVC; sawed slots, 35-50 feet
Annulus and Gravel Pack Record:	Benseal, 0-20 feet; gravel pack, 20-50 feet
Ground Elevation:	493 feet above mean sea level (msl), topographic map
Measuring Point:	Top of well casing (TOC), 3.0 feet above land surface (lsd)
Nonpumping Water Level:	13.77 feet below TOC, 10:35 am, October 17, 1996 10.49 feet below TOC, 9:48 am, July 31, 1997 10.81 feet below TOC, 10:31 am, August 5, 1997
Location:	Approximately 870 feet South and 2735 feet East of the NW/corner, Section 10, T.7 N., R.9 E., Jasper County, Illinois
Remarks:	

DRILLERS LOG

Formation	From *(feet)*	To *(feet)*
Dark brown clay	0	14
Gray mud	14	16
Coarse sand and fine gravel mix	16	35
Medium to coarse sand, some fine gravel	35	40
Gray mud streak	40	41
Coarse sand and fine to medium gravel mix	41	50
Gray shale	50	51

OBSERVATION WELL NO. 4 DATA

Observation Well No.:	4
Distance and Direction from Pumped Well 11:	422 feet North
Distance and Direction from Pumped Well 12:	53.2 feet South
Site:	Embarras River Valley
Drilling Contractor:	Speth Plumbing, Inc.
Date Drilled:	June 1997
Drilling Method:	Straight rotary
Depth:	51 feet
Hole Record:	6-inch; 0-51 feet
Casing Record:	2-inch PVC, +2.5-30 feet
Screen Record:	2-inch PVC; sawed slots, 30-50 feet
Annulus and Gravel Pack Record:	Benseal, 0-20 feet; gravel pack, 20-50 feet
Ground Elevation:	493 feet above mean sea level (msl), topographic map
Measuring Point:	Top of well casing (TOC), 2.5 feet above land surface (lsd)
Nonpumping Water Level:	9.93 feet below TOC, 9:49 am, July 31, 1997 10.25 feet below TOC, 10:27 am, August 5, 1997
Location:	Approximately 945 feet South and 2735 feet East of the NW/corner, Section 10, T.7 N., R.9 E., Jasper County, Illinois
Remarks:	

DRILLERS LOG

Formation	From *(feet)*	To *(feet)*
Not available		

TEST BORING NO. 4 DATA

Observation Well No.:	Test Boring 4
Distance and Direction from Pumped Well 11:	39.8 feet North
Distance and Direction from Pumped Well 12:	435 feet South
Site:	Embarras River Valley
Drilling Contractor:	Speth Plumbing, Inc.
Date Drilled:	June 25, 1996
Drilling Method:	Auger, continuous flight
Depth:	51 feet
Hole Record:	5-inch; 0-51 feet
Casing Record:	2-inch galvanized pipe, +5.3-48 feet
Screen Record:	2-inch sand point; 48-51 feet; 60 gauze; 3 feet long
Annulus and Gravel Pack Record:	Benseal, 0-20 feet; gravel pack, 20-50 feet
Ground Elevation:	493 feet above mean sea level (msl), topographic map
Measuring Point:	Top of well casing (TOC), 5.3 feet above land surface (lsd)
Nonpumping Water Level:	15.51 feet below TOC, 11:09 am, October 17, 1996
Location:	Approximately 1333 feet South and 2715 feet East of the NW/corner, Section 10, T.7 N., R.9 E., Jasper County, Illinois
Remarks:	

DRILLERS LOG

Formation	From *(feet)*	To *(feet)*
Sandy clay	0	15
Coarse sand	15	22
Coarse sand and fine gravel mix	22	51
Gray shale	51	52

Appendix C.

Sieve Data and Design Recommendations for Production Well 11

Sieve Data for Aquifer Samples

E J Water Company, Inc

Test Hole (site of production Well 11)
Drilled by Speth Plumbing, Inc.
Drilled June 24, 1996
Samples sieved by State Geological Survey, July 1996

Depth	*Sample*	*U.S. Sieves, # / opening size, in mm*											
(ft)	*Weight*	*#5*	*#7*	#70	*#14*	*#18*	*#25*	*#35*	*#45*	*#60*	*#80*	*#120*	*Pan*
	(g)	*4.00*	*2.80*	*2.00*	*1.400*	*1.000*	*0.710*	*0.500*	*0.355*	*0.250*	*0.177*	*0.125*	
		(Cumulative Percent Retained)											
25- 30	89.57	12.8	40.7	51.2	63.0	77.7	83.7	88.1	-	98.7	-	-	100.0
35- 40	194.2	10.4	21.2	32.8	45.8	56.4	60.8	64.6	-	87.3	-	-	99.9
40- 45	103.3	1.3	-	5.9	-	10.5	12.8	17.7	36.6	70.9	91.2	96.3	99.9
45- 50	164.9	1.3	-	3.4	-	5.5	7.6	15.9	42.1	70.3	90.0	96.6	99.9

Production Well 11
Northern Gravel Company, Well Pack No. 0, placed in annulus from 25 to 51.5 feet
Samples sieved by Illinois State Geological Survey, November 1996

Sample	*U.S. Sieves, #/opening size, in mm*									
Weight	*#10*	*#12*	*#14*	*#16*	*#18*	*#20*	*#25*	*#30*	*#35*	*Pan*
(g)	*2.00*	*1.70*	*1.40*	*1.180*	*1.000*	*0.850*	*0.710*	*0.600*	*0.500*	
	(Cumulative Percent Retained)									
136.4	0.9	3.6	11.0	24.9	47.1	72.6	89.6	96.7	99.0	100.0

Note: Letter dated July 12, 1996, suggested Northern Gravel Company Well Pack Coarse #0. These sieve results meet specifications for Well Pack #0.

ILLINOIS DEPARTMENT OF NATURAL RESOURCES

Illinois State Water Survey

Main Office • 2204 Griffith Drive • Champaign. IL 61820-7495 • *Tel (217) 333-2210' Fax (217) 333-6540*
Peoria Office • P.O. Box 697• Peoria IL 61652-0697 • *Tel(309) 671-3196-Fax (309)671-3106*

SWS

July 12, 1996

Mr. David Klitzing
General Manager
E J Water Corporation
P.O. Box 8
Dieterich, IL 61424

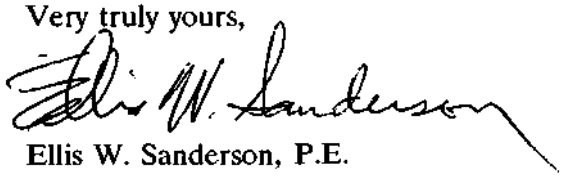
Dear Mr. Klitzing:

We understand that you desire our design suggestion for the well screen and gravel pack for a Test Well (proposed production Well 11, first well, South Well Field) for the E J Water Corporation. We have examined the sieve analysis data for the samples collected by Speth Plumbing, Inc. The Test Well is located approximately 1400 ft South and 2700 ft West of the NE corner, Section 10, T.7 N., R.9 E., Jasper County. We understand that a pumping rate of 200 to 300 gallons per minute (gpm) is desired from the new production well at this site. Whether the sand and gravel aquifer has suitable hydraulic properties and areal extent to sustain this pumping rate is to be evaluated with a constant-rate aquifer test.

The sieve analysis data, the desired production rate, and our well design criteria indicate that a gravel packed well design is warranted. Based on the grain size distribution of the sand and gravel aquifer samples from depths of 40 to 50 feet, a gravel pack with a grain size of about 1.0 to 1.6 mm would be ideal for this interval of the sand and gravel aquifer. If material from Northern Gravel Company, Muscatine, IA, is used, our information suggests their Coarse No. 0 material is about 0.9 to 1.8 mm in size and should be satisfactory for use. This information should be verified directly from the company. A well screen with a slot size of 0.040-inch (40 slot) can be used with this gravel pack. For the desired production rate of about 300 gpm, a 12-inch diameter well screen about 15 feet long set between depths of about 35 to 50 feet is suggested. A bore hole diameter of 24 to 30 inches is suggested.

Please do not hesitate to contact us if you have any questions about this matter.

Very truly yours,



Ellis W. Sanderson, P.E.
Senior Engineer
Office of Ground-Water Resources
Evaluation and Management
Phone: (217) 333-0235

cc: Speth Plumbing, Inc.
Milano and Grunloh Engineers, Inc.
IEPA (2)
R. Brower, ISGS

ILLINOIS
DEPARTMENT OF NATURAL RESOURCES

ILLINOIS STATE GEOLOGICAL SURVEY

Natural Resources Building
615 East Peabody Drive
Champaign, IL 61820-6964
217/333-4747
FAX 217/244-7004

July 15, 1996

Mr. David F. Klitzing, Mgr
E. J. Water Corporation
P.O. Box 8
Dieterich, IL 62424

Re: E. J. Water Corp. Well # 11

Per your request a sieve analysis was conducted on selected, washed, rotary samples delivered to the Geological Survey June 27th from E. J. Water Corporation Well #11 that is being constructed in the South Well Field near the site of Test Hole #4-95. Your spotted location for the well has been identified as being very approximately 1400 feet from the north line, 2500 feet from the west line of Section 10, T. 7N., R.9E., Jasper County, Illinois. We understand the corporation plans to develop this production well with a yield capacity of about 250 to 300 gpm.

A summary of the sieve analysis results is reported below as cumulative percent of sample retained on the designated mesh sieves. Invoice #121 is enclosed to cover the cost of running the sieve analysis in the ISGS Geotechnical Laboratory. Please send remittance as directed in the two boxes at the bottom of the invoice. The analysis results have been faxed to the State Water Survey to assist them in developing a recommended design for this water supply well.

Sand and gravel began at a depth of about 10 feet and extended to a position somewhere between 35 and 40 feet. We did not receive a log from the Speth Incorporated to indicate the depth of transition from sand and gravel to fine to medium sand. Fine to medium sand is reported by the driller to be in contact with a shale of the Pennsylvanian-age Mattoon Formation at a depth of 51 feet. The apparent relatively broad distribution of aquifer material' in the immediate vicinity of this well should provide a fair to good potential for yielding the desired 250 to 300 gpm to a properly designed and constructed well.

A visual examination given the samples while selecting intervals for analysis was used to compare sample intervals not sieved with those that were run through an analysis. The sample from 20 to 25 feet is somewhat coarser-grained than the sample from 25 to 30 feet and probably has a bimodal distribution similar to that noted in the sample from 25 to 30 feet. This bimodal distribution has resulted from interbedded layers of finer-grained material (medium sand) with the coarse sand to fine gravel that makes up the bulk of the sample. A similar situation exists for the sample from 30 to 35 feet when compared with the samples immediately above and below it. Although the sample from 30 to 35 feet is more similar to the over-lying sample; the presence of a somewhat greater amount of medium sand lowers the median grain size to an estimated value of 0.065 to 0.075 inch. The position of transition from sand and gravel to fine to medium sand is expected to lie within the depth interval of about 36 to 37 feet. Each sample below 40 feet included a few grains of fine gravel. Most of this gravel was lying on top of each sample when the sample bags were opened. Many of the gravel clasts were somewhat iron-stained and similar in appearance to the gravel found at shallower depths in this boring.

E. J. Water Corporation Well #11
1400 ft N.L., 2500 ft W.L.
Section 10, T. 7N., R.9E., Jasper County

Job No. J938				
Lab No. Sample Depth	10747 25-30 ft	10748 35-40 ft	10749 40-45 ft	10750 45-50 ft
Sieve Mesh Size Inch mm				
0.312 8.00	0.0%	0.5%	-	-
0.157 4.00	12.8	10.4	1.3%	1.3%
0.111 2.83	40.7	21.2	-	-
0.079 2.00	51.2	32.8	5.9	3.4
0.056 1.41	63.0	46.8	-	-
0.039 1.00	77.7	56.4	10.5	5.5
0.028 0.71	83.7	60.8	12.8	7.6
0.020 0.500	88.1	64.6	17.7	15.9
0.014 0.350	-	-	36.6	42.1
0.010 0.250	98.7	87.3	70.9	70.3
0.007 0.177	-	-	91.2	90.0
0.005 0.125	-	-	96.3	96.6
PAN	100.0	99.9	99.9	99.9

A summary description of the samples is given on the attachment. A copy of the Speth's well log for this well was received as this paragraph was being written.

If there are any questions regarding this analysis or the geologic conditions in the vicinity of the test hole, please feel free to contact the State Geological Survey.

Sincerely yours,

Ross D. Brower RDB
Staff Geologist
Groundwater Resources and Protection Section

RDB:ey

Enclosures:

cc: E.W. Sanderson, SWS
IEPA-PWS (2 copies)

RDBltr07.156

Description of drill samples
From E. J. Water Corporation Well #11
Driller- Speth Incorporated

~1400 ft from north line, 2500 ft from west line
Section 10, T.7N., R.9E., Jasper County

Clay, some sand	0 - 10 feet
Dark very coarse sand to fine gravel, some coarse sand, some(+) medium gravel	10 - 15
Same but lighter in color	15 - 20
Very coarse sand to fine gravel, some(+) medium gravel, some(-) coarse gravel	20 - 25
Coarse sand to fine gravel, some(-) medium gravel, trace coarse gravel, some to little medium sand	25 - 30
Coarse sand to fine gravel, little(+) medium gravel, some/ little medium sand, trace fine sand; estimated median grain size- 0.065 to 0.075 inch	30 - 35
Medium sand to fine gravel, trace medium gravel	35 - 40
Medium sand, some(+) fine sand, little(-) very fine sand, some coarse to very coarse sand, trace fine gravel; somewhat less coarser-grained material downward; most of gravel appeared at top of sample and was fairly heavily iron-stained	40 - 50 (*)

(*) driller indicated base of fine to medium sand at 51 feet.

by R. Brower 7/2/1996

Appendix D.

Step Test: Production Well 11

Ground-Water Investigation in the Embarras River Valley for E J Water Corporation
Test/Production Well 11 II Step Test: October 15, 1996

Date/ Hour	*Elapsed Time (min)*	*Well 11 Depth to water (ft)*	*OW 1 Depth to water (ft)*	*Piezometer head (ft)*	*Pumping rate (gpm)*	*Remarks*
10/15/96						
08:59 AM		11.02				Steel tape
09:02 AM			13.29			Steel tape
09:19 AM		39.32	12.66			Transmitter heads
09:21 AM	0	11.03	13.29			Logging started
09:22 AM	1	11.02	13.29			Water level trend
09:23 AM	2	11.02	13.29			
09:24 AM	3	11.02	13.29			
09:25 AM	4	11.02	13.29			
09:26 AM	5	11.02	13.29			
09:27 AM	6	11.02	13.29			
09:28 AM	7	11.02	13.29			
09:29 AM	8	11.02	13.29			
09:30 AM	9	11.02	13.29			
09:31 AM	10	11.01	13.29			
09:32 AM	11	11.01	13.29			
09:33 AM	12	11.01	13.29			
09:34 AM	13	11.01	13.29			
09:35 AM	14	11.01	13.29			
09:36 AM	15	11.01	13.29			
09:37 AM	16	11.01	13.29			
09:38 AM	17	11.01	13.29			
09:39 AM	18	11.01	13.29			
09:40 AM	19	11.01	13.29			
09:41AM	20	11.01	13.29			
09:42 AM	21	11.01	13.29			
09:43 AM	22	11.01	13.29			
09:44 AM	23	11.01	13.29			
09:45 AM	24	11.01	13.28			
09:46 AM	25	11.00	13.29			
09:47 AM	26	11.00	13.28			
09:48 AM	27	11.00	13.28			
09:49 AM	28	11.00	13.29			
09:50 AM	29	11.00	13.28			
09:51 AM	30	11.00	13.28			
09:52 AM	31	11.00	13.29			
09:53 AM	32	11.00	13.28			
09:54 AM	33	11.00	13.28			
09:55 AM	34	11.00	13.28			
09:56 AM	35	11.00	13.28			
09:57 AM	36	11.00	13.28			
09:58 AM	37	11.00	13.28			
09:59 AM	38	11.00	13.28			
10:00 AM	39	11.00	13.28			
10:01 AM	40	11.00	13.28			
10:02 AM	41	11.00	13.28			
10:03 AM	42	11.00	13.28			
10:04 AM	43	11.00	13.28			
10:05 AM	44	11.00	13.28			
10:06 AM	45	11.00	13.28			
10:07 AM	46	11.00	13.28			
10:08 AM	47	11.00	13.28			
10:09 AM	48	11.00	13.28			
10:10 AM	49	11.06	13.28			
10:11 AM	50	11.06	13.28			
10:12 AM	51	11.05	13.28			
10:13 AM	52	11.04	13.28			
10:14 AM	53	11.03	13.28			
10:15 AM	54	11.15	13.28			
10:16 AM	55	11.07	13.29			
10:17 AM	56	11.04	13.28			
10:18 AM	57	11.03	13.29			
10:19 AM	58	11.03	13.28			
10:20 AM	59	11.02	13.28			
10:21 AM	60	11.01	13.28			

Ground-Water Investigation in the Embarras River Valley for E J Water Corporation
Test/Production Well 11 II Step Test: October 15, 1996

Date/ Hour	*Elapsed Time* (mm)	*Well 11 Depth to water* (ft)	*OW 1 Depth to water* (ft)	*Piezometer head* (ft)	*Pumping rate* (gpm)	*Remarks*
10:22 AM	61	11.00	13.28			
10:23 AM	62	11.00	13.28			
10:24 AM	63	11.00	13.28			
10:25 AM	0	11.00	13.29			Pump ON
10:26 AM	1	20.85	13.39	0.88	100	Step 1
10:27 AM	2	21.94	13.49	0.85	99	Adjust rate
10:28 AM	3	22.58	13.55	0.88	101	
10:29 AM	4	22.65	13.61			
10:30 AM	5	22.59	13.65			
10:31 AM	6	22.58	13.68			
10:32 AM	7	22.57	13.71			
10:33 AM	8	22.57	13.74	0.85	99	Adjust rate
10:34 AM	9	22.62	13.76			
10:35 AM	10	22.72	13.78	0.87	100	
10:36 AM	11	22.75	13.81			
10:37 AM	12	22.73	13.82			
10:38 AM	13	22.86	13.84			
10:39 AM	14	22.94	13.86			
10:40 AM	15	22.91	13.87			
10:41 AM	16	22.89	13.89	0.88	101	
10:42 AM	17	22.84	13.91			
10:43 AM	18	22.82	13.92			
10:44 AM	19	22.86	13.93	0.88	101	
10:45 AM	20	22.81	13.94			
10:46 AM	21	22.86	13.95			
10:47 AM	22	22.84	13.97	0.88	101	
10:48 AM	23	22.82	13.97			
10:49 AM	24	22.89	13.99			
10:50 AM	25	22.82	13.99			
10:51 AM	26	22.87	14.01	0.88	101	
10:52 AM	27	22.86	14.01			
10:53 AM	28	22.87	14.03	0.88	101	
10:54 AM	29	22.84	14.04			
10:55 AM	30	22.88	14.04	0.88	101	Increase rate
10:56 AM	1	24.57	14.07	1.26	120	Step 2
10:57 AM	2	24.84	14.09	1.25		Adjust rate
10:58 AM	3	25.11	14.12	1.26	120	
10:59 AM	4	25.07	14.13			
11:00 AM	5	25.07	14.15	1.27	121	
11:01AM	6	25.23	14.16	1.28	122	
11:02 AM	7	25.24	14.18	1.28	122	
11:03 AM	8	25.23	14.19	1.27	121	
11:04 AM	9	25.21	14.20			
11:05 AM	10	25.27	14.21	1.27	121	
11:06 AM	11	25.28	14.22			
11:07 AM	12	25.27	14.23			
11:08 AM	13	25.31	14.24	1.27	121	
11:09 AM	14	25.33	14.25			
11:10 AM	15	25.30	14.26			
11:11AM	16	25.34	14.26	1.28	122	
11:12 AM	17	25.34	14.28			
11:13 AM	18	25.33	14.29			
11:14 AM	19	25.35	14.30			
11:15 AM	20	25.37	14.30	1.28	122	
11:16 AM	21	25.37	14.31			
11:17 AM	22	25.40	14.32	1.27	121	
11:18 AM	23	25.40	14.33			
11:19 AM	24	25.33	14.33	1.27	121	
11:20 AM	25	25.36	14.34			
11:21 AM	26	25.37	14.35			
11:22 AM	27	25.38	14.35			
11:23 AM	28	25.38	14.35	1.27	121	
11:24 AM	29	25.38	14.37			
11:25 AM	30	25.39	14.37	1.27	121	Increase rate
11:26 AM	1	26.92	14.39	1.70	140	Step 3

Ground-Water Investigation in the Embarras River Valley for E J Water Corporation
Test/Production Well 11 ll Step Test: October 15, 1996

Date/ Hour	*Elapsed Time (min)*	*Well 11 Depth to water (ft)*	*OW 1 Depth to water (ft)*	*Piezometer head (ft)*	*Pumping rate (gpm)*	*Remarks*
11:27 AM	2	27.34	14.42	1.70	140	
11:28 AM	3	27.36	14.43			
11:29 AM	4	27.48	14.44	1.70	140	
11:30 AM	5	27.50	14.46			
11:31AM	6	27.58	14.47	1.71	141	
11:32 AM	7	27.53	14.49			
11:33 AM	8	27.58	14.50	1.70	140	
11:34 AM	9	27.63	14.50			
11:35 AM	10	27.68	14.52	1.71	141	
11:36 AM	11	27.70	14.52			
11:37 AM	12	27.68	14.53			
11:38 AM	13	27.65	14.54			
11:39AM	14	27.67	14.55	1.71	141	
11:40 AM	15	27.70	14.56			
11:41 AM	16	27.68	14.57			
11:42 AM	17	27.69	14.57			
11:43 AM	18	27.72	14.58	1.70	140	
11:44 AM	19	27.64	14.58			
11:45 AM	20	27.58	14.59			
11:46 AM	21	27.71	14.59			
11:47 AM	22	27.73	14.61	1.70	140	
11:48 AM	23	27.73	14.61			
11:49 AM	24	27.73	14.62			
11:50 AM	25	27.70	14.62			
11:51AM	26	27.76	14.62	1.70	140	
11:52 AM	27	27.74	14.63			
11:53 AM	28	27.73	14.64			
11:54 AM	29	27.75	14.64	1.70	140	
11:55 AM	30	27.72	14.65	1.69		Increase rate
11:56 AM	1	29.58	14.67	2.22	160	Step 4
11:57 AM	2	30.01	14.69	2.22	160	
11:58 AM	3	30.12	14.71	2.22	160	
11:59 AM	4	30.17	14.73			
12:00 PM	5	30.16	14.74			
12:01 PM	6	30.23	14.76	2.22	160	
12:02 PM	7	30.22	14.76			
12:03 PM	8	30.26	14.78	2.21	160	
12:04 PM	9	30.31	14.78			
12:05 PM	10	30.31	14.79	2.21	160	
12:06 PM	11	30.29	14.80			
12:07 PM	12	30.36	14.81			
12:08 PM	13	30.32	14.82			
12:09 PM	14	30.35	14.83	2.20		Adjust rate
12:10 PM	15	30.38	14.83			
12:11 PM	16	30.41	14.84	2.22	160	
12:12 PM	17	30.52	14.84			
12:13 PM	18	30.53	14.85	2.22	160	
12:14 PM	19	30.51	14.86			
12:15 PM	20	30.53	14.86			
12:16 PM	21	30.53	14.87			
12:17 PM	22	30.47	14.87			
12:18 PM	23	30.49	14.89			
12:19 PM	24	30.56	14.88			
12:20 PM	25	30.58	14.89	2.21	160	
12:21 PM	26	30.58	14.89			
12:22 PM	27	30.66	14.90			
12:23 PM	28	30.64	14.91	2.22	160	
12:24 PM	29	30.64	14.91			
12:25 PM	30	30.65	14.91	2.21	160	Increase rate
12:26 PM	1	32.49	14.93	2.79	180	Step 5
12:27 PM	2	32.82	14.96	2.79	180	
12:28 PM	3	32.97	14.98	2.79	180	
12:29 PM	4	32.98	15.00			
12:30 PM	5	33.00	15.01	2.76		Adjust rate
12:31 PM	6	33.05	15.02	2.78	180	

Ground-Water Investigation in the Embarras River Valley for E J Water Corporation
Test/Production Well 11 II Step Test: October 15, 1996

Date/ Hour	*Elapsed Time (min)*	*Well 11 Depth to water (ft)*	*OW 1 Depth to water (ft)*	*Piezometer head (ft)*	*Pumping rate (gpm)*	*Remarks*
12:32 PM	7	33.11	15.02			
12:33 PM	8	33.14	15.04	2.78	180	
12:34 PM	9	33.23	15.05			
12:35 PM	10	33.25	15.06	2.78	180	
12:36 PM	11	33.28	15.07			
12:37 PM	12	33.34	15.07	2.78	180	
12:38 PM	13	33.39	15.08			
12:39 PM	14	33.39	15.09	2.78	180	
12:40 PM	15	33.39	15.10			
12:41 PM	16	33.44	15.10			
12:42 PM	17	33.48	15.11			
12:43 PM	18	33.44	15.11			
12:44 PM	19	33.48	15.12			
12:45 PM	20	33.51	15.12	2.78	180	Water sample collected;
12:46 PM	21	33.56	15.13			T = 56 3° F
12:47 PM	22	33.53	15.14			
12:48 PM	23	33.56	15.14			
12:49 PM	24	33.59	15.15	2.78	180	
12:50 PM	25	33.60	15.16			
12:51PM	26	33.58	15.16			
12:52 PM	27	33.69	15.17			
12:53 PM	28	33.68	15.17	2.78	180	
12:54 PM	29	33.72	15.18			
12:55 PM	30	33.72	15.18	2.78	180	End of Step Test
12:56 PM		33.71	15.18			
12:57 PM		33.74	15.19			
12:58 PM		33.72	15.19			
12:59 PM		33.73	15.20			
01:00 PM		33.75	15.20			
01:01 PM		33.75	15.21			
01:02 PM		33.79	15.21			
01:03 PM		33.78	15.21			
01:04 PM		30.41	15.20			
01:05 PM		29.75	15.17			
01:06 PM		29.60	15.14			
01:07 PM		28.84	15.12			
01:08 PM		53.21				Adjusting pumping rate for
01:09 PM		28.65				start of constant rate test
01:10 PM		28.65				
01:11 PM		28.63				
01:12 PM		28.67				
01:13 PM		28.78				
01:14 PM		28.72				
01:15 PM		28.78				
01:16 PM		28.72				Pump OFF

Appendix E.

Four-Day Aquifer Test: Production Well 11

Ground-Water Investigation in the Embarras River Valley for E J Water Corporation
Test/Production Well 11 II Four-day Aquifer Test: October 17-21, 1996

Date/ Hour	Elapsed lime (min)	Well 11 Depth to water (ft)	Well 11 Observed dnvdwn (ft)	Test Boring 4 Depth to water (ft)	Test Boring 4 Observed dnvdwn (ft)	Observation Well 1 Depth to water (ft)	Observation Well 1 Observed dnvdwn (ft)	Observation Well 2 Depth to water (ft)	Observation Well 2 Observed dnvdwn (ft)	Observation Well 3 Depth to water (ft)	Observation Well 3 Obsen'ed dnvdwn W	Approx barometric pressure (psia)	Piezometer head (ft)	Pumping rate (gpm)	Remarks
10/17/96															
10:33 AM										10.28					Set head
10:35 AM										13.77					Steel tape
10:38 AM								13.67							Steel tape
10:40 AM								14.57							Set head
10:45 AM				18.21											Set head
11:04 AM						13.42									Steel tape
11:05 AM		32.89				15.13									Set head
11:07 AM		11.00													Steel tape
11:09 AM				15.51											Steel tape
11:13AM	0	10.94		15.51		13.45		13.72		13.80		14.37			Begin data logging
11:18AM	5	10.90		15.51		13.42		13.68		13.78		14.37			Water level trend
11:23 AM	10	10.98		15.50		13.44		13.70		13.79		14.37			
11:28 AM	15	11.01		15.50		13.43		13.68		13.78		14.37			
11:33 AM	20	11.08		15.50		13.44		13.69		13.79		14.37			
11:38 AM	25	11.07		15.50		13.42		13.66		13.75		14.37			
11:40 AM	0	10.96	-0.04	15.50	0.00	13.41	-0.01	13.66	0.00	13.76	-0.01	14.37			Pump ON
	0.0083	10.96	-0.04	15.50	0.00	13.41	-0.01	13.65	-0.01	13.77	0.00	14.37			
	0.0166	15.21	4.21	15.50	0.00	13.41	-0.01	13.66	0.00	13.77	0.00	14.37			
	0.0250	21.09	10.09	15.50	0.00	13.41	-0.01	13.66	0.00	13.77	0.00	14.37			
	0.0333	13.54	2.54	15.51	0.01	13.41	-0.01	13.66	0.00	13.77	0.00	14.37			
	0.0416	7.32	-3.68	15.54	0.04	13.41	-0.01	13.66	0.00	13.77	0.00	14.37			
	0.0500	18.90	7.90	15.50	0.00	13.41	-0.01	13.66	0.00	13.77	0.00	14.37			
	0.0583	21.44	10.44	15.50	0.00	13.42	0.00	13.66	0.00	13.77	0.00	14.37			
	0.0666	14.59	3.59	15.50	0.00	13.41	-0.01	13.66	0.00	13.77	0.00	14.37			
	0.0750	12.91	1.91	15.50	0.00	13.42	0.00	13.66	0.00	13.77	0.00	14.37			
	0.0833	17.22	6.22	15.52	0.02	13.42	0.00	13.66	0.00	13.77	0.00	14.37			
	0.0916	18.02	7.02	15.51	0.01	13.41	-0.01	13.66	0.00	13.77	0.00	14.37			
	0.1000	16.00	5.00	15.52	0.02	13.42	0.00	13.66	0.00	13.77	0.00	14.37			
	0.1083	15.90	4.90	15.52	0.02	13.42	0.00	13.66	0.00	13.77	0.00	14.37			
	0.1166	17.26	6.26	15.53	0.03	13.42	0.00	13.66	0.00	13.77	0.00	14.37			
	0.1250	17.45	6.45	15.54	0.03	13.42	0.00	13.66	0.00	13.77	0.00	14.37			
	0.1333	16.95	5.95	15.54	0.03	13.42	0.00	13.65	-0.01	13.77	0.00	14.37			
	0.1416	17.15	6.15	15.54	0.04	13.42	0.00	13.66	0.00	13.77	0.00	14.37			
	0.1500	17.65	6.65	15.55	0.05	13.42	0.00	13.66	0.00	13.77	0.00	14.37			
	0.1583	17.72	6.72	15.55	0.05	13.42	0.00	13.66	0.00	13.77	0.00	14.37			
	0.1666	17.69	6.69	15.59	0.09	13.43	0.01	13.66	0.00	13.77	0.00	14.37			
	0.1750	17.89	6.89	15.61	0.11	13.42	0.00	13.66	0.00	13.77	0.00	14.37			
	0.1833	18.10	7.10	15.58	0.08	13.43	0.01	13.66	0.00	13.77	0.00	14.37			
	0.1916	18.20	7.20	15.59	0.09	13.43	0.01	13.67	0.01	13.77	0.00	14.37			
	0.2000	18.25	7.25	15.62	0.12	13.43	0.01	13.67	0.01	13.77	0.00	14.37			
	0.2083	18.45	7.45	15.60	0.10	13.43	0.01	13.66	0.00	13.77	0.00	14.37			
	0.2166	18.59	7.59	15.62	0.12	13.43	0.01	13.66	0.00	13.77	0.00	14.37			
	0.2250	18.70	7.70	15.63	0.13	13.43	0.01	13.66	0.00	13.77	0.00	14.37			
	0.2333	18.81	7.81	15.64	0.14	13.43	0.01	13.66	0.00	13.77	0.00	14.37			
	0.2416	18.94	7.94	15.65	0.15	13.44	0.02	13.66	0.00	13.77	0.00	14.37			
	0.2500	19.05	8.05	15.66	0.16	13.43	0.01	13.67	0.01	13.77	0.00	14.37			
	0.2583	19.12	8.12	15.66	0.16	13.44	0.02	13.66	0.00	13.77	0.00	14.37			

Ground-Water Investigation in the Embarras River Valley for E J Water Corporation
Test/Production Well 11 II Four-day Aquifer Test: October 17-21, 1996

Dale / Hour	Elapsed time (min)	Well 11 Depth to water (ft)	Well 11 Observed drwdwn (ft)	Test Boring 4 Depth to water (ft)	Test Boring 4 Observed drwdwn (ft)	Observation Well I Depth to water (ft)	Observation Well I Observed drwdwn (ft)	Observation Well 2 Depth to water (ft)	Observation Well 2 Observed drwdwn (ft)	Observation Well 3 Depth to water (ft)	Observation Well 3 Observed drwdwn (ft)	Approx barometric pressure (psia)	Piezometer head (ft)	Pumping rate (gpm)	Remarks
	0.2666	19.28	8.28	15.68	0.18	13.44	0.02	13.66	0.00	13.77	0.00	14.37			
	0.2750	19.37	8.37	15.69	0.19	13.44	0.02	13.66	-0.00	13.77	0.00	14.37			
	0.2833	19.47	8.47	15.70	0.20	13.44	0.02	13.67	0.01	13.77	0.00	14.37			
	0.2916	19.61	8.61	15.71	0.21	13.44	0.02	13.66	0.00	13.77	0.00	14.37			
	0.3000	19.73	8.73	15.72	0.22	13.44	0.02	13.65	-0.01	13.77	0.00	14.37			
	0.3083	19.81	8.81	15.73	0.23	13.45	0.02	13.65	-0.01	13.77	0.00	14.37			
	0.3166	19.91	8.91	15.74	0.24	13.44	0.02	13.66	0.00	13.77	0.00	14.37			
	0.3250	20.01	9.01	15.74	0.24	13.45	0.02	13.66	0.00	13.77	0.00	14.37			
	0.3333	20.10	9.10	15.75	0.25	13.45	0.02	13.66	0.00	13.77	0.00	14.37			
	0.3500	20.29	9.29	15.77	0.27	13.45	0.03	13.66	0.00	13.77	0.00	14.37			
	0.3666	20.47	9.47	15.77	0.27	13.45	0.03	13.66	0.00	13.77	0.00	14.37			
	0.3833	20.66	9.66	15.80	0.30	13.46	0.04	13.67	0.01	13.77	0.00	14.37			
	0.4000	20.81	9.81	15.82	0.32	13.46	0.04	13.66	0.00	13.77	0.00	14.37			
	0.4166	20.99	9.99	15.86	0.36	13.46	0.04	13.67	0.01	13.77	0.00	14.37			
	0.4333	21.14	10.14	15.88	0.38	13.46	0.04	13.66	0.00	13.77	0.00	14.37			
	0.4500	21.30	10.30	15.89	0.39	13.47	0.05	13.66	0.00	13.77	0.00	14.37			
	0.4666	21.44	10.44	15.91	0.41	13.47	0.05	13.67	0.01	13.77	0.00	14.37			
	0.4833	21.60	10.60	15.94	0.44	13.48	0.06	13.67	0.01	13.77	0.00	14.37			
	0.5000	21.73	10.73	15.96	0.46	13.48	0.06	13.67	0.01	13.77	0.00	14.37			
	0.5166	21.86	10.86	15.96	0.46	13.48	0.06	13.67	0.01	13.77	0.00	14.37			
	0.5333	22.00	11.00	15.98	0.48	13.48	0.06	13.67	0.01	13.77	0.00	14.37			
	0.5500	22.12	11.12	15.99	0.49	13.49	0.06	13.67	0.01	13.77	0.00	14.37			
	0.5666	22.24	11.24	16.02	0.52	13.49	0.07	13.67	0.01	13.77	0.00	14.37			
	0.5833	22.32	11.32	16.04	0.54	13.49	0.07	13.67	0.01	13.77	0.00	14.37			
	0.6000	22.45	11.45	16.05	0.55	13.49	0.07	13.67	0.01	13.77	0.00	14.37			
	0.6166	22.57	11.57	16.07	0.57	13.50	0.07	13.67	0.01	13.77	0.00	14.37			
	0.6333	22.67	11.67	16.10	0.59	13.50	0.08	13.68	0.02	13.77	0.00	14.37			
	0.6500	22.77	11.77	16.11	0.61	13.50	0.08	13.68	0.02	13.77	0.00	14.37			
	0.6666	22.88	11.88	16.13	0.63	13.50	0.08	13.68	0.02	13.77	0.00	14.37			
	0.6833	23.00	12.00	16.14	0.64	13.51	0.09	13.68	0.02	13.77	0.00	14.37			
	0.7000	23.08	12.08	16.15	0.65	13.51	0.09	13.68	0.02	13.77	0.00	14.37			
	0.7166	23.15	12.15	16.16	0.66	13.52	0.10	13.68	0.02	13.77	0.00	14.37			
	0.7333	23.24	12.24	16.18	0.68	13.52	0.10	13.68	0.02	13.77	0.00	14.37			
	0.7500	23.31	12.31	16.20	0.70	13.52	0.10	13.68	0.02	13.77	0.00	14.37			
	0.7666	23.43	12.43	16.22	0.72	13.52	0.10	13.68	0.02	13.77	0.00	14.37			
	0.7833	23.49	12.49	16.23	0.73	13.52	0.10	13.69	0.03	13.77	0.00	14.37			
	0.8000	23.58	12.58	16.25	0.75	13.53	0.11	13.69	0.03	13.77	0.00	14.37			
	0.8166	23.64	12.64	16.26	0.76	13.53	0.11	13.69	0.03	13.77	0.00	14.37			
	0.8333	23.76	12.76	16.28	0.78	13.54	0.12	13.69	0.03	13.77	0.00	14.37			
	0.8500	23.80	12.80	16.30	0.80	13.54	0.12	13.69	0.03	13.77	0.00	14.37			
	0.8666	23.89	12.89	16.28	0.78	13.55	0.13	13.69	0.03	13.77	0.00	14.37			
	0.8833	23.94	12.94	16.32	0.82	13.54	0.12	13.69	0.03	13.77	0.00	14.37			
	0.9000	24.01	13.01	16.33	0.83	13.55	0.13	13.69	0.03	13.77	0.00	14.37			
	0.9166	24.07	13.07	16.34	0.84	13.55	0.13	13.70	0.04	13.77	0.00	14.37			
	0.9333	24.13	13.13	16.36	0.86	13.55	0.13	13.70	0.03	13.77	0.00	14.37			
	0.9500	24.19	13.19	16.37	0.87	13.56	0.14	13.70	0.04	13.77	0.00	14.37			
	0.9666	24.23	13.23	16.39	0.89	13.56	0.14	13.70	0.04	13.77	0.00	14.37			
	0.9833	24.34	13.34	16.40	0.90	13.56	0.14	13.70	0.04	13.77	0.00	14.37			

Ground-Water Investigation in the Embarras River Valley for E J Water Corporation
Test/Production Well 11 II Four-day Aquifer Test: October 17-21, 1996

Date/ Hour	Elapsed lime (min)	Well 11 Depth to water (ft)	Well 11 Observed drwdwn (ft)	Test Boring 4 Depth to water (ft)	Test Boring 4 Observed drwdwn (ft)	Observation Well 1 Depth to water (ft)	Observation Well 1 Observed drwdwn (ft)	Observation Well 2 Depth to water (ft)	Observation Well 2 Observed drwdwn (ft)	Observation Well 3 Depth to water (ft)	Observation Well 3 Observed drwdwn (ft)	Approx barometric pressure (psia)	Piezometer head (ft)	Pumping rate (gpm)	Remarks
11:41 AM	1.0	24.38	13.38	16.41	0.91	13.56	0.14	13.70	0.04	13.77	0.00	14.37	1.81	145	
	1.2	24.96	13.96	16.54	1.04	13.60	0.18	13.71	0.05	13.77	0.00	14.37			
	1.4	25.37	14.37	16.64	1.14	13.62	0.20	13.73	0.07	13.77	0.00	14.37			
	1.6	25.70	14.70	16.73	1.23	13.65	0.23	13.75	0.09	13.77	0.00	14.37	1.79	144	
	1.8	25.96	14.96	16.81	1.31	13.68	0.26	13.77	0.11	13.78	0.01	14.37			
11:42 AM	2.0	26.18	15.18	16.88	1.38	13.71	0.29	13.79	0.13	13.78	0.01	14.37	1.75	143	
	2.2	26.36	15.36	16.95	1.45	13.74	0.32	13.82	0.16	13.79	0.02	14.37			
	2.4	26.49	15.49	16.99	1.49	13.76	0.34	13.84	0.18	13.80	0.03	14.37			
	2.6	26.59	15.59	17.03	1.53	13.78	0.36	13.85	0.19	13.80	0.03	14.37			
	2.8	26.69	15.69	17.08	1.58	13.80	0.38	13.86	0.20	13.80	0.03	14.37			
11:43 AM	3.0	26.80	15.80	17.12	1.62	13.82	0.39	13.87	0.21	13.80	0.03	14.37			
	3.2	26.82	15.82	17.14	1.64	13.84	0.42	13.89	0.23	13.80	0.03	14.37			
	3.4	26.90	15.90	17.18	1.68	13.85	0.43	13.90	0.24	13.80	0.03	14.37			
	3.6	26.99	15.99	17.20	1.70	13.86	0.44	13.90	0.24	13.80	0.03	14.37			
	3.8	27.02	16.02	17.23	1.73	13.87	0.45	13.91	0.25	13.80	0.03	14.37			
11:44 AM	4.0	27.06	16.06	17.25	1.75	13.88	0.46	13.92	0.26	13.80	0.03	14.37			
	4.2	27.14	16.14	17.26	1.76	13.89	0.47	13.93	0.27	13.81	0.04	14.37			
	4.4	27.16	16.16	17.29	1.79	13.90	0.48	13.93	0.27	13.80	0.03	14.37			
	4.6	27.16	16.16	17.30	1.80	13.92	0.50	13.94	0.28	13.80	0.03	14.37			
	4.8	27.25	16.25	17.32	1.82	13.93	0.51	13.95	0.29	13.80	0.03	14.37			
11:45 AM	5.0	27.25	16.25	17.34	1.84	13.94	0.52	13.97	0.31	13.80	0.03	14.37			
	5.2	27.25	16.25	17.36	1.86	13.94	0.52	13.97	0.31	13.80	0.03	14.37			
	5.4	27.31	16.31	17.37	1.87	13.95	0.53	13.97	0.31	13.80	0.03	14.37			
	5.6	27.33	16.33	17.39	1.89	13.96	0.54	13.98	0.32	13.80	0.03	14.37			
	5.8	27.32	16.32	17.40	1.90	13.98	0.56	13.99	0.33	13.80	0.03	14.37			
11:46 AM	6.0	27.39	16.39	17.41	1.91	13.99	0.56	14.00	0.34	13.81	0.04	14.37			
	6.2	27.35	16.35	17.42	1.92	14.00	0.58	14.00	0.34	13.81	0.04	14.37			
	6.4	27.40	16.40	17.44	1.94	14.00	0.58	14.02	0.36	13.81	0.04	14.37			
	6.6	27.45	16.45	17.46	1.96	14.02	0.60	14.02	0.36	13.81	0.04	14.37			
	6.8	27.44	16.44	17.46	1.96	14.03	0.61	14.03	0.37	13.81	0.04	14.37			
11:47 AM	7.0	27.51	16.51	17.49	1.99	14.03	0.61	14.04	0.38	13.82	0.05	14.37	1.73	141	
	7.2	27.50	16.50	17.49	1.99	14.03	0.61	14.04	0.38	13.82	0.05	14.37			
	7.4	27.46	16.46	17.49	1.99	14.04	0.61	14.04	0.38	13.82	0.05	14.37			
	7.6	27.52	16.52	17.51	2.01	14.05	0.63	14.05	0.39	13.82	0.05	14.37			
	7.8	27.50	16.50	17.51	2.01	14.06	0.64	14.07	0.41	13.82	0.05	14.37			
11:48 AM	8.0	27.55	16.55	17.54	2.04	14.06	0.64	14.06	0.40	13.82	0.05	14.37			
	8.2	27.52	16.52	17.53	2.03	14.07	0.65	14.07	0.40	13.82	0.05	14.37			
	8.4	27.52	16.52	17.54	2.04	14.07	0.65	14.07	0.41	13.82	0.05	14.37			
	8.6	27.55	16.55	17.55	2.05	14.08	0.66	14.07	0.41	13.82	0.05	14.37			
	8.8	27.56	16.56	17.56	2.06	14.09	0.67	14.08	0.42	13.83	0.06	14.37			
11:49 AM	9.0	27.59	16.59	17.57	2.07	14.10	0.68	14.09	0.43	13.84	0.07	14.37	1.74	141	
	9.2	27.59	16.59	17.56	2.06	14.11	0.69	14.10	0.44	13.83	0.06	14.37	1.73	141	
	9.4	27.58	16.58	17.58	2.08	14.11	0.69	14.11	0.45	13.84	0.07	14.37			
	9.6	27.60	16.60	17.59	2.09	14.12	0.70	14.12	0.46	13.84	0.07	14.37			
	9.8	27.63	16.63	17.60	2.10	14.13	0.71	14.12	0.46	13.84	0.07	14.37			
11:50 AM	10	27.60	16.60	17.60	2.10	14.13	0.71	14.12	0.46	13.85	0.07	14.37			
11:52 AM	12	27.68	16.68	17.67	2.17	14.18	0.76	14.17	0.51	13.85	0.08	14.37			
11:54 AM	14	27.85	16.85	17.71	2.21	14.23	0.81	14.21	0.55	13.87	0.10	14.37	1.73	141	

Ground-Water Investigation in the Embarras River Valley for E J Water Corporation
Test/Production Well 11 II Four-day Aquifer Test: October 17-21, 1996

		Well 11		Test Boring 4		Observation Well 1		Observation Well 2		Observation Well 3					
Date / Hour	Elapsed time (min)	Depth to water (ft)	Observed drwdwn (ft)	Depth to water (ft)	Observed drwdwn (ft)	Depth to water (ft)	Observed drwdwn (ft)	Depth to water (ft)	Observed drwdwn (ft)	Depth to water (ft)	Observed drwdwn (ft)	Approx barometric pressure (psia)	Piezometer head (ft)	Pumping rate (gpm)	Remarks
11:56 AM	16	27.93	16.93	17.76	2.26	14.27	0.85	14.24	0.58	13.89	0.12	14.37			
11:58 AM	18	27.85	16.85	17.80	2.30	14.30	0.88	14.27	0.61	13.90	0.13	14.37			
12:00 PM	20	27.89	16.89	17.85	2.35	14.34	0.92	14.30	0.64	13.91	0.14	14.37			
12:02 PM	22	27.99	16.99	17.87	2.37	14.37	0.94	14.33	0.67	13.93	0.16	14.37	1.74	141	
12:04 PM	24	27.95	16.95	17.92	2.42	14.39	0.97	14.36	0.69	13.94	0.17	14.37			
12:06 PM	26	28.02	17.02	17.94	2.44	14.43	1.01	14.40	0.74	13.96	0.19	14.37			
12:08 PM	28	28.13	17.13	17.97	2.47	14.45	1.03	14.41	0.75	13.97	0.20	14.37	1.74	141	
12:10 PM	30	28.10	17.10	17.99	2.49	14.47	1.05	14.43	0.77	13.97	0.20	14.37			
12:12 PM	32	28.11	17.11	18.01	2.51	14.50	1.08	14.45	0.79	13.99	0.22	14.37			
12:14 PM	34	28.05	17.05	18.04	2.54	14.51	1.09	14.47	0.81	14.00	0.23	14.37			
12:16 PM	36	28.11	17.11	18.05	2.55	14.53	1.11	14.48	0.82	14.00	0.23	14.37			
12:18 PM	38	28.23	17.23	18.07	2.57	14.55	1.13	14.50	0.84	14.02	0.25	14.37			
12:20 PM	40	28.14	17.14	18.09	2.58	14.57	1.15	14.51	0.85	14.02	0.25	14.37			
12:22 PM	42	28.18	17.18	18.10	2.60	14.58	1.16	14.53	0.87	14.02	0.25	14.36			
12:24 PM	44	28.18	17.18	18.13	2.63	14.60	1.18	14.55	0.89	14.03	0.26	14.37			
12:26 PM	46	28.04	17.04	18.14	2.64	14.61	1.19	14.54	0.88	14.04	0.27	14.37			
12:28 PM	48	27.95	16.95	18.16	2.66	14.63	1.21	14.57	0.91	14.06	0.29	14.37			
12:30 PM	50	28.11	17.11	18.18	2.68	14.66	1.24	14.62	0.96	14.08	0.31	14.37			
12:32 PM	52	28.28	17.28	18.19	2.69	14.67	1.25	14.62	0.96	14.09	0.32	14.37			
12:34 PM	54	28.28	17.28	18.21	2.71	14.68	1.26	14.62	0.96	14.08	0.31	14.36			
12:36 PM	56	28.32	17.32	18.21	2.71	14.69	1.27	14.63	0.97	14.09	0.32	14.36			
12:38 PM	58	28.30	17.30	18.22	2.72	14.70	1.27	14.64	0.98	14.09	0.32	14.36			
12:40 PM	60	28.31	17.31	18.24	2.74	14.71	1.29	14.65	0.99	14.11	0.34	14.36			
12:42 PM	62	28.24	17.24	18.26	2.75	14.72	1.30	14.66	1.00	14.10	0.33	14.36			
12:44 PM	64	28.29	17.29	18.27	2.77	14.74	1.32	14.67	1.01	14.13	0.35	14.36			
12:46 PM	66	28.33	17.33	18.28	2.78	14.75	1.33	14.68	1.02	14.13	0.35	14.36			
12:48 PM	68	28.36	17.36	18.29	2.79	14.76	1.34	14.69	1.03	14.13	0.36	14.36			
12:50 PM	70	28.32	17.32	18.31	2.81	14.77	1.35	14.71	1.05	14.13	0.36	14.36			
12:52 PM	72	28.36	17.36	18.31	2.81	14.79	1.37	14.72	1.06	14.14	0.37	14.36			
12:54 PM	74	28.48	17.48	18.31	2.81	14.80	1.38	14.72	1.06	14.16	0.39	14.36			
12:56 PM	76	28.37	17.37	18.33	2.83	14.80	1.38	14.73	1.07	14.15	0.38	14.36			
12:58 PM	78	28.54	17.54	18.34	2.84	14.81	1.39	14.74	1.08	14.17	0.40	14.36			
01:00 PM	80	28.53	17.53	18.34	2.84	14.82	1.40	14.75	1.09	14.16	0.39	14.36	1.73	141	
01:02 PM	82	28.46	17.46	18.36	2.86	14.81	1.39	14.73	1.07	14.15	0.38	14.36			
01:04 PM	84	28.41	17.41	18.37	2.87	14.85	1.43	14.78	1.12	14.19	0.42	14.36	1.72	141	Adjust rate
01:06 PM	86	28.63	17.63	18.37	2.87	14.84	1.42	14.77	1.11	14.19	0.42	14.36	1.77	144	
01:08 PM	88	28.63	17.63	18.41	2.91	14.86	1.44	14.80	1.14	14.19	0.42	14.36			
01:10PM	90	28.68	17.68	18.41	2.91	14.86	1.44	14.79	1.13	14.19	0.42	14.36			
01:12 PM	92	28.78	17.78	18.43	2.93	14.87	1.45	14.80	1.14	14.19	0.42	14.36			
01:14 PM	94	28.67	17.67	18.43	2.93	14.87	1.45	14.80	1.14	14.20	0.43	14.36			
01:16 PM	96	28.75	17.75	18.44	2.94	14.91	1.49	14.83	1.17	14.21	0.44	14.36			
01:18PM	98	28.69	17.69	18.46	2.96	14.90	1.48	14.83	1.17	14.21	0.44	14.35			
01:20 PM	100	28.79	17.79	18.46	2.96	14.92	1.50	14.84	1.18	14.21	0.44	14.36			
01:40 PM	120	28.77	17.77	18.54	3.04	14.98	1.56	14.90	1.24	14.26	0.49	14.35	1.76	144	River stage = 0.18
02:00 PM	140	28.90	17.90	18.59	3.09	15.04	1.62	14.94	1.28	14.29	0.51	14.35	1.76	144	
02:20 PM	160	28.90	17.90	18.65	3.15	15.11	1.69	15.01	1.35	14.34	0.57	14.35	1.77	144	
02:40 PM	180	28.95	17.95	18.70	3.20	15.15	1.73	15.05	1.39	14.37	0.60	14.34			
03:00 PM	200	28.94	17.94	18.74	3.24	15.19	1.77	15.08	1.42	14.39	0.62	14.33			

Ground-Water Investigation in the Embarras River Valley for E J Water Corporation
Test/Production Well 11 II Four-day Aquifer Test: October 17-21, 1996

Date/ Hour	Elapsed lime (min)	Well 11 Depth to water (ft)	Well 11 Observed drwdwn (ft)	Test Boring 4 Depth to water (ft)	Test Boring 4 Observed drwdwn (ft)	Observation Well 1 Depth to water (ft)	Observation Well 1 Observed drwdwn (ft)	Observation Well 2 Depth to water (ft)	Observation Well 2 Observed drwdwn (ft)	Observation Well 3 Depth to water (ft)	Observation Well 3 Observed drwdwn (ft)	Approx barometric pressure (psia)	Piezometer head (ft)	Pumping rate (gpm)	Remarks
03:20 PM	220	28.87	17.87	18.77	3.27	15.23	1.81	15.11	1.45	14.42	0.65	14.33			
03:40 PM	240	28.78	17.78	18.83	3.33	15.28	1.86	15.16	1.50	14.45	0.68	14.34			
04:00 PM	260	28.87	17.87	18.85	3.35	15.31	1.89	15.19	1.53	14.48	0.71	14.34	1.77	144	
04:20 PM	280	28.91	17.91	18.88	3.38	15.35	1.93	15.22	1.56	14.50	0.73	14.33			
04:40 PM	300	28.75	17.75	18.92	3.42	15.38	1.96	15.25	1.59	14.52	0.75	14.34			
05:00 PM	320	28.78	17.78	18.95	3.45	15.41	1.99	15.28	1.62	14.54	0.77	14.33	1.77	144	
05:20 PM	340	28.75	17.75	18.97	3.47	15.44	2.02	15.30	1.64	14.56	0.79	14.34			
05:40 PM	360	28.81	17.81	18.99	3.49	15.46	2.04	15.32	1.66	14.57	0.79	14.33			
06:00 PM	380	28.81	17.81	19.01	3.51	15.48	2.06	15.34	1.68	14.58	0.81	14.33	1.77	144	
06:20 PM	400	28.82	17.82	19.03	3.53	15.49	2.07	15.35	1.69	14.59	0.82	14.32			River stage = 0.18'
06:40 PM	420	28.93	17.93	19.06	3.56	15.53	2.11	15.39	1.73	14.62	0.85	14.33			
07:00 PM	440	28.86	17.86	19.08	3.58	15.55	2.13	15.41	1.75	14.63	0.85	14.34	1.77	144	
07:20 PM	460	28.58	17.58	19.13	3.63	15.60	2.18	15.44	1/78	14.66	0.89	14.35			
07:40 PM	480	28.51	17.51	19.14	3.64	15.61	2.19	15.46	1.80	14.67	0.90	14.34			
08:00 PM	500	28.60	17.60	19.19	3.69	15.66	2.24	15.51	1.85	14.71	0.94	14.36	1.77	144	
08:20 PM	520	28.56	17.56	19.19	3.69	15.66	2.24	15.51	1.85	14.71	0.94	14.36			
08:40 PM	540	28.49	17.49	19.18	3.68	15.65	2.23	15.50	1.84	14.70	0.93	14.34			
09:00 PM	560	28.53	17.53	19.21	3.71	15.69	2.27	15.53	1.87	14.73	0.96	14.36	1.77	144	
09:20 PM	580	28.52	17.52	19.23	3.73	15.71	2.29	15.55	1.89	14.74	0.97	14.36			
09:40 PM	600	28.35	17.35	19.21	3.71	15.70	2.28	15.53	1.87	14.74	0.96	14.35			
10:00 PM	620	28.42	17.42	19.25	3.75	15.74	2.31	15.57	1.91	14.76	0.99	14.37	1.77	144	
10:20 PM	640	28.33	17.33	19.27	3.77	15.75	2.33	15.58	1.92	14.78	1.01	14.37			
10:40 PM	660	28.27	17.27	19.29	3.79	15.78	2.36	15.60	1.94	14.79	1.02	14.38			
11:00 PM	680	28.24	17.24	19.31	3.81	15.80	2.38	15.62	1.96	14.81	1.04	14.39	1.77	144	
11:20 PM	700	28.30	17.30	19.31	3.81	15.80	2.38	15.62	1.96	14.80	1.03	14.38			
11:40 PM	720	28.40	17.40	19.32	3.82	15.80	2.38	15.63	1.97	14.81	1.04	14.38			
10/18/96															
12:00 AM	740	28.37	17.37	19.32	3.82	15.81	2.39	15.64	1.98	14.81	1.04	14.38	1.77	144	
12:20 AM	760	28.21	17.21	19.33	3.83	15.81	2.39	15.64	1.98	14.82	1.05	14.38			
12:40 AM	780	28.36	17.36	19.33	3.83	15.82	2.40	15.65	1.99	14.82	1.05	14.38			
01:00 AM	800	28.25	17.25	19.34	3.84	15 83	2.41	15.65	1.99	14.83	1.06	14.38	1.77	144	
01:20 AM	820	28.27	17.27	19.35	3.85	15.84	2.42	15.66	2.00	14.84	1.07	14.38			
01:40 AM	840	28.23	17.23	19.36	3.86	15.85	2.43	15.67	2.01	14.85	1.08	14.38			
02:00 AM	860	28.21	17.21	19.37	3.87	15.85	2.43	15.67	2.01	14.85	1.08	14.38	1.77	144	
02:20 AM	880	28.32	17.32	19.37	3.87	15.86	2.44	15.68	2.02	14.86	1.09	14.39			
02:40 AM	900	28.32	17.32	19.37	3.87	15.87	2.45	15.68	2.02	14.86	1.09	14.38			
03:00 AM	920	28.28	17.28	19.38	3.88	15.88	2.46	15.69	2.03	14.87	1.10	14.38	1.77	144	
03:20 AM	940	28.19	17.19	19.40	3.90	15.88	2.46	15.70	2.04	14.87	1.10	14.38			
03:40 AM	960	28.26	17.26	19.39	3.89	15.89	2.47	15.70	2.04	14.87	1.10	14.38			
04:00 AM	980	28.24	17.24	19.41	3.91	15.90	2.48	15.72	2.06	14.88	1.11	14.39	1.77	144	
04:20 AM	1000	28.31	17.31	19.41	3.91	15.91	2.49	15.73	2.07	14.89	1.12	14.39			
04:40 AM	1020	28.26	17.26	19.42	3.92	15.91	2.49	15.73	2.07	14.90	1.13	14.39			
05:00 AM	1040	28.19	17.19	19.43	3.93	15.92	2.50	15.73 .	2.07	14.90	1.13	14.39	1.77	144	
05:20 AM	1060	28.31	17.31	19.44	3.94	15.93	2.51	15.74	2.08	14.91	1.14	14.39			
05:40 AM	1080	28.18	17.18	19.45	3.95	15.94	2.52	15.75	2.09	14.92	1.14	14.39			
06:00 AM	1100	28.25	17.25	19.45	3.95	15.95	2.53	15.76	2.10	14.92	1.14	14.40	1.77	144	
06:20 AM	1120	28.25	17.25	19.45	3.95	15.95	2.53	15.76	2.10	14.92	1.15	14.40			
06:40 AM	1140	28.22	17.22	19.47	3.97	15.96	2.54	15.77	2.11	14.93	1.16	14.40			

Ground-Water Investigation in the Embarras River Valley for E J Water Corporation
Test/Production Well 11 II Four-day Aquifer Test: October 17-21, 1996

Date/ Hour	Elapsed time (min)	Well 11 Depth to water (ft)	Well 11 Observed drwdwn (ft)	Test Boring 4 Depth to water (ft)	Test Boring 4 Observed drwdwn (ft)	Observation Well 1 Depth to water (ft)	Observation Well 1 Observed drwdwn (ft)	Observation Well 2 Depth to water (ft)	Observation Well 2 Observed drwdwn (ft)	Observation Well 3 Depth to water (ft)	Observation Well 3 Observed drwdwn (ft)	Approx barometric pressure (psia)	Piezometer head (ft)	Pumping rate (gpm)	Remarks
07:00 AM	1160	28.24	17.24	19.48	3.98	15.96	2.54	15.78	2.12	14.93	1.16	14.40	1.77	144	
07:20 AM	1180	28.19	17.19	19.48	3.98	15.97	2.55	15.78	2.12	14.94	1.17	14.40			
07:40 AM	1200	28.36	17.36	19.49	3.99	15.98	2.56	15.79	2.13	14.94	1.17	14.40			
08:00 AM	1220	28.39	17.39	19.50	4.00	15.99	2.57	15.80	2.14	14.95	1.18	14.41	1.77	144	
08:20 AM	1240	28.37	17.37	19.50	4.00	16.00	2.58	15.80	2.14	14.96	1.18	14.41			
08:40 AM	1260	28.42	17.42	19.50	4.00	16.00	2.58	15.80	2.14	14.96	1.19	14.41			
09:00 AM	1280	28.46	17.46	19.51	4.01	16.01	2.58	15.81	2.15	14.97	1.19	14.42	1.77	144	
09:20 AM	1300	28.57	17.57	19.52	4.02	16.02	2.60	15.81	2.15	14.97	1.20	14.42			
09:40 AM	1320	28.49	17.49	19.53	4.03	16.02	2.60	15.82	2.16	14.97	1.20	14.42			
10:00 AM	1340	28.74	17.74	19.55	4.05	16.03	2.61	15.83	2.17	14.97	1.20	14.42	1.78	144	
10:20 AM	1360	28.73	17.73	19.55	4.05	16.03	2.61	15.84	2.18	14.98	1.21	14.43			
10:40 AM	1380	28.76	17.76	19.55	4.05	16.04	2.62	15.84	2.18	14.98	1.21	14.43			
11:00 AM	1400	28.69	17.69	19.55	4.05	16.04	2.62	15.85	2.19	14.99	1.22	14.43	1.75	142	Adjust rate
11:20 AM	1420	28.81	17.81	19.57	4.07	16.05	2.63	15.85	2.19	14.99	1.22	14.43	1.77	144	
11:40 AM	1440	28.86	17.86	19.58	4.08	16.05	2.63	15.85	2.19	14.99	1.22	14.43			
12:00 PM	1460	28.90	17.90	19.58	4.08	16.06	2.64	15.86	2.20	14.99	1.22	14.43	1.76	144	
12:20 PM	1480	28.94	17.94	19.58	4.08	16.06	2.64	15.86	2.20	15.00	1.23	14.43			
12:40 PM	1500	28.97	17.97	19.58	4.08	16.07	2.65	15.87	2.21	15.00	1.23	14.43			
01:00 PM	1520	28.86	17.86	19.58	4.08	16.07	2.65	15.87	2.21	15.00	1.23	14.43	1.77	144	
01:20 PM	1540	28.89	17.89	19.59	4.09	16.07	2.65	15.87	2.21	15.00	1.23	14.43			
01:40 PM	1560	28.94	17.94	19.60	4.10	16.08	2.66	15.88	2.22	15.01	1.24	14.43			
02:00 PM	1580	28.94	17.94	19.60	4.10	16.08	2.66	15.88	2.22	15.01	1.24	14.43	1.78	144	
02:20 PM	1600	29.06	18.06	19.62	4.12	16.08	2.66	15.88	2.22	15.02	1.25	14.43			
02:40 PM	1620	29.04	18.04	19.62	4.12	16.09	2.67	15.88	2.22	15.01	1.24	14.43			
03:00 PM	1640	29.06	18.06	19.63	4.13	16.10	2.68	15.89	2.23	15.02	1.25	14.43	1.78	144	
03:20 PM	1660	29.00	18.00	19.63	4.13	16.11	2.69	15.90	2.24	15.03	1.26	14.43			
03:40 PM	1680	29.07	18.07	19.65	4.15	16.11	2.69	15.91	2.25	15.04	1.27	14.43			
04:00 PM	1700	29.06	18.06	19.65	4.15	16.12	2.70	15.91	2.25	15.03	1.26	14.44	1.78	144	
04:20 PM	1720	29.06	18.06	19.65	4.15	16.13	2.71	15.92	2.26	15.05	1.28	14.44			
04:33 PM								16.02							Steel tape
04:35 PM										15.06					Steel tape
04:38 PM				19.66											Steel tape
04:39 PM						16.18									Steel tape
04:40 PM		29.86													Steel tape
04:40 PM	1740	29.03	18.03	19.66	4.16	16.14	2.72	15.92	2.26	15.05	1.28	14.44			
05:00 PM	1760	29.01	18.01	19.66	4.16	16.13	2.71	15.92	2.26	15.05	1.28	14.44	1.78	144	Water sample collected
05:20 PM	1780	28.94	17.94	19.67	4.17	16.14	2.72	15.93	2.27	15.05	1.28	14.44			River stage = 0.18'
05:40 PM	1800	28.86	17.86	19.67	4.17	16.15	2.73	15.94	2.28	15.06	1.29	14.44			
06:00 PM	1820	28.92	17.92	19.68	4.18	16.15	2.73	15.94	2.28	15.06	1.29	14.44	1.77	144	
06:20 PM	1840	28.81	17.81	19.68	4.18	16.16	2.74	15.94	2.28	15.07	1.29	14.45			
06:40 PM	1860	28.66	17.66	19.68	4.18	16.16	2.74	15.94	2.28	15.07	1.30	14.45			
07:00 PM	1880	28.74	17.74	19.68	4.18	16.16	2.74	15.95	2.29	15.07	1.30	14.44	1.77	144	
07:20 PM	1900	28.73	17.73	19.68	4.18	16.17	2.75	15.95	2.29	15.08	1.31	14.44			
07:40 PM	1920	28.54	17.54	19.68	4.18	16.17	2.75	15.95	2.29	15.08	1.31	14.44			
08:00 PM	1940	28.52	17.52	19.69	4.19	16.17	2.75	15.95	2.29	15.08	1.31	14.44	1.77	144	
08:20 PM	1960	28.62	17.62	19.68	4.18	16.17	2.75	15.96	2.30	15.08	1.31	14.44			
08:40 PM	1980	28.52	17.52	19.69	4.19	16.18	2.75	15.96	2.30	15.08	1.31	14.44			
09:00 PM	2000	28.58	17.58	19.69	4.19	16.18	2.75	15.96	2.30	15.08	1.31	14.44	1.76	144	

Ground-Water Investigation in the Embarras River Valley for E J Water Corporation
Test/Production Well 11 II Four-day Aquifer Test: October 17-21, 1996

Date/ Hour	Elapsed time (min)	Well 11 Depth to water (ft)	Well 11 <Observed drwdwn (ft)	Test Boring 4 Depth to water (ft)	Test Boring 4 Observed drwdwn (ft)	Observation Well 1 Depth to water (ft)	Observation Well 1 Observed drwdwn (ft)	Observation Well 2 Depth to water (ft)	Observation Well 2 Observed drwdwn (ft)	Observation Well 3 Depth to water (ft)	Observation Well 3 Observed drwdwn (ft)	Approx barometric pressure (psia)	Piezometer head (ft)	Pumping rate (gpm)	Remarks
09:20 PM	2020	28.52	17.52	19.69	4.19	16.18	2.76	15.96	2.30	15.09	1.32	14.43			
09:40 PM	2040	28.47	17.47	19.70	4.20	16.18	2.76	15.97	2.31	15.09	1.32	14.43			
10:00 PM	2060	28.61	17.61	19.70	4.20	16.19	2.77	15.97	2.31	15.09	1.32	14.43	1.78	144	
10:20 PM	2080	28.70	17.70	19.72	4.22	16.20	2.78	15.98	2.32	15.10	1.33	14.43			
10:40 PM	2100	28.67	17.67	19.72	4.22	16.20	2.78	15.99	2.33	15.10	1.33	14.43			
11:00 PM	2120	28.59	17.59	19.72	4.22	16.20	2.78	15.99	2.33	15.10	1.33	14.43	1.77	144	
11:20 PM	2140	28.70	17.70	19.74	4.24	16.21	2.79	15.99	2.33	15.11	1.34	14.43			
11:40 PM	2160	28.62	17.62	19.74	4.24	16.21	2.79	16.00	2.34	15.11	1.34	14.43			
10/19/96															
12:00 AM	2180	28.61	17.61	19.74	4.24	16.21	2.79	16.00	2.34	15.11	1.34	14.42	1.77	144	
12:20 AM	2200	28.59	17.59	19.74	4.24	16.22	2.80	16.00	2.34	15.11	1.34	14.42			
12:40 AM	2220	28.69	17.69	19.75	4.25	16.22	2.80	16.01	2.34	15.12	1.35	14.42			
01:00 AM	2240	28.61	17.61	19.75	4.25	16.23	2.81	16.01	2.35	15.12	1.35	14.42	1.77	144	
01:20 AM	2260	28.66	17.66	19.75	4.25	16.23	2.81	16.01	2.35	15.12	1.35	14.42			
01:40 AM	2280	28.56	17.56	19.76	4.26	16.24	2.82	16.02	2.36	15.12	1.35	14.42			
02:00 AM	2300	28.66	17.66	19.77	4.27	16.24	2.82	16.02	2.36	15.13	1.36	14.42	1.78	144	
02:20 AM	2320	28.60	17.60	19.77	4.27	16.24	2.82	16.02	2.36	15.13	1.36	14.42			
02:40 AM	2340	28.64	17.64	19.78	4.28	16.25	2.83	16.03	2.37	15.14	1.37	14.42			
03:00 AM	2360	28.60	17.60	19.78	4.28	16.25	2.83	16.03	2.37	15.14	1.37	14.42	1.77	144	
03:20 AM	2380	28.65	17.65	19.78	4.28	16.26	2.84	16.03	2.37	15.14	1.37	14.42			
03:40 AM	2400	28.66	17.66	19.80	4.30	16.26	2.84	16.04	2.38	15.14	1.37	14.42			
04:00 AM	2420	28.69	17.69	19.81	4.31	16.27	2.85	16.04	2.38	15.15	1.38	14.42	1.79	144	
04:20 AM	2440	28.71	17.71	19.81	4.31	16.27	2.85	16.05	2.39	15.15	1.38	14.42			
04:40 AM	2460	28.78	17.78	19.81	4.31	16.28	2.86	16.05	2.39	15.15	1.38	14.42			
05:00 AM	2480	28.77	17.77	19.81	4.31	16.28	2.86	16.06	2.40	15.15	1.38	14.42	1.80	145	
05:20 AM	2500	28.69	17.69	19.82	4.32	16.28	2.86	16.06	2.40	15.16	1.39	14.42			
05:40 AM	2520	28.80	17.80	19.82	4.32	16.29	2.87	16.06	2.40	15.16	1.39	14.42			
06:00 AM	2540	28.69	17.69	19.82	4.32	16.29	2.87	16.07	2.41	15.17	1.40	14.43	1.78	144	
06:20 AM	2560	28.75	17.75	19.82	4.32	16.29	2.87	16.07	2.41	15.17	1.40	14.43			
06:40 AM	2580	28.72	17.72	19.83	4.33	16.30	2.88	16.07	2.41	15.17	1.40	14.43			
07:00 AM	2600	28.75	17.75	19.84	4.34	16.30	2.88	16.08	2.42	15.17	1.40	14.43	1.79	144	
07:20 AM	2620	28.71	17.71	19.84	4.34	16.30	2.88	16.08	2.42	15.18	1.41	14.43			
07:40 AM	2640	28.86	17.86	19.85	4.35	16.31	2.89	16.09	2.43	15.18	1.41	14.43			
08:00 AM	2660	28.62	17.62	19.83	4.33	16.31	2.89	16.09	2.43	15.19	1.42	14.44	1.79	144	
08:20 AM	2680	28.74	17.74	19.82	4.32	16.31	2.89	16.09	2.43	15.19	1.42	14.44			
08:40 AM	2700	28.75	17.75	19.82	4.32	16.31	2.89	16.09	2.43	15.19	1.42	14.44			
09:00 AM	2720	28.71	17.71	19.82	4.32	16.31	2.89	16.09	2.42	15.19	1.42	14.45	1.77	144	
09:20 AM	2740	28.80	17.80	19.82	4.32	16.32	2.90	16.09	2.43	15.19	1.42	14.46			
09:40 AM	2760	28.86	17.86	19.82	4.32	16.32	2.90	16.10	2.44	15.19	1.42	14.46			
10:00 AM	2780	28.89	17.89	19.82	4.32	16.32	2.90	16.09	2.43	15.19	1.42	14.47	1.77	144	
10:20 AM	2800	28.85	17.85	19.82	4.32	16.32	2.90	16.09	2.43	15.19	1.42	14.47			
10:40 AM	2820	28.94	17.94	19.83	4.33	16.33	2.91	16.10	2.44	15.20	1.43	14.47			
11:00 AM	2840	29.13	18.13	19.84	4.34	16.33	2.91	16.11	2.45	15.20	1.43	14.48	1.78	144	
11:20 AM	2860	29.15	18.15	19.84	4.34	16.33	2.91	16.10	2.44	15.20	1.43	14.48			
11:40 AM	2880	29.15	18.15	19.84	4.34	16.33	2.91	16.10	2.44	15.20	1.43	14.48			
12:00 PM	2900	29.11	18.11	19.84	4.34	16.33	2.91	16.11	2.45	15.20	1.43	14.47	1.77	144	
12:20 PM	2920	29.10	18.10	19.84	4.34	16.33	2.91	16.11	2.45	15.20	1.43	14.47			
12:40 PM	2940	29.18	18.18	19.84	4.34	16.33	2.91	16.11	2.45	15.20	1.43	14.47			

Ground-Water Investigation in the Embarras River Valley for E J Water Corporation
Test/Production Well 11 II Four-day Aquifer Test: October 17-21, 1996

Date / Hour	Elapsed time (min)	Well 11 Depth to water (ft)	Well 11 Observed drwdwn (ft)	Test Boring 4 Depth to water (ft)	Test Boring 4 Observed drwdwn (ft)	Observation Well I Depth to water (ft)	Observation Well I Observed drwdwn (ft)	Observation Well 2 Depth to water (ft)	Observation Well 2 Observed drwdwn (ft)	Observation Well 3 Depth to water (ft)	Observation Well 3 Observed drwdwn (ft)	Approx barometric pressure (psia)	Piezometer head (ft)	Pumping rate (gP» >)	Remarks
01:00 PM	2960	29.22	18.22	19.84	4.34	16.33	2.91	16.11	2.45	15.20	1.43	14.47	1.77	144	
01:20 PM	2980	29.15	18.15	19.84	4.34	16.33	2.91	16.10	2.44	15.20	1.43	14.46			
01:40 PM	3000	29.29	18.29	19.84	4.34	16.33	2.91	16.11	2.45	15.20	1.43	14.46			
02:00 PM	3020	29.20	18.20	19.84	4.34	16.34	2.91	16.11	2.45	15.20	1.43	14.46	1.77	144	
02:20 PM	3040	29.30	18.30	19.84	4.34	16.33	2.91	16.10	2.44	15.19	1.42	14.45			
02:40 PM	3060	29.27	18.27	19.84	4.34	16.34	2.91	16.10	2.44	15.20	1.43	14.45			
03:00 PM	3080	29.27	18.27	19.84	4.34	16.33	2.91	16.11	2.45	15.20	1.43	14.45	1.77	144	
03:20 PM	3100	29.35	18.35	19.84	4.34	16.34	2.91	16.11	2.45	15.20	1.43	14.44			
03:40 PM	3120	29.39	18.39	19.85	4.35	16.34	2.92	16.11	2.45	15.20	1.43	14.44			
04:00 PM	3140	29.32	18.32	19.86	4.36	16.34	2.92	16.11	2.45	15.20	1.43	14.44	1.76	144	
04:20 PM	3160	29.27	18.27	19.86	4.36	16.34	2.92	16.12	2.46	15.21	1.44	14.43			
04:40 PM	3180	29.27	18.27	19.86	4.36	16.34	2.92	16.11	2.45	15.21	1.44	14.43			
05:00 PM	3200	29.32	18.32	19.86	4.36	16.34	2.92	16.11	2.45	15.21	1.44	14.43	1.77	144	
05:20 PM	3220	29.21	18.21	19.86	4.36	16.35	2.93	16.12	2.46	15.21	1.44	14.43			
05:40 PM	3240	29.15	18.15	19.86	4.36	16.35	2.93	16.12	2.46	15.21	1.44	14.43			
06:00 PM	3260	29.11	18.11	19.86	4.36	16.35	2.93	16.13	2.47	15.22	1.45	14.43	1.77	144	
06:20 PM	3280	29.03	18.03	19.87	4.37	16.36	2.94	16.13	2.47	15.22	1.45	14.42			
06:40 PM	3300	28.92	17.92	19.87	4.37	16.36	2.94	16.14	2.48	15.23	1.46	14.42			
07:00 PM	3320	28.99	17.99	19.88	4.38	16.37	2.95	16.14	2.48	15.23	1.46	14.42	1.77	144	
07:20 PM	3340	28.89	17.89	19.89	4.39	16.37	2.95	16.15	2.49	15.23	1.46	14.42			
07:40 PM	3360	28.85	17.85	19.88	4.38	16.37	2.95	16.15	2.49	15.23	1.46	14.41			
08:00 PM	3380	28.84	17.84	19.89	4.39	16.37	2.95	16.15	2.49	15.24	1.46	14.41	1.77	144	
08:20 PM	3400	28.83	17.83	19.89	4.39	16.38	2.96	16.15	2.49	15.24	1.47	14.41			
08:40 PM	3420	28.89	17.89	19.89	4.39	16.38	2.96	16.15	2.49	15.24	1.46	14.40			
09:00 PM	3440	28.77	17.77	19.87	4.37	16.37	2.95	16.15	2.49	15.24	1.46	14.40	1.76	144	
09:20 PM	3460	29.09	18.09	19.92	4.42	16.39	2.97	16.16	2.50	15.24	1.47	14.40			
09:40 PM	3480	29.01	18.01	19.92	4,42	16.39	2.97	16.16	2.50	15.24	1.47	14.39			
10:00 PM	3500	29.15	18.15	19.93	4.43	16.40	2.98	16.16	2.50	15.25	1.47	14.39	1.78	144	
10:20 PM	3520	28.93	17.93	19.92	4.42	16.40	2.98	16.16	2.50	15.25	1.48	14.39			
10:40 PM	3540	28.97	17.97	19.92	4.42	16.40	2.98	16.17	2.51	15.25	1.48	14.39			
11:00 PM	3560	28.96	17.96	19.92	4 42	16.40	2.98	16.17	2.51	15.25	1.48	14.39	1.78	144	
11:20 PM	3580	28.98	17.98	19.92	4.42	16.40	2,98	16.17	2.51	15.25	1.48	14.38			
11:40 PM	3600	28.95	17.95	19.92	4.42	16.40	2.98	16.17	2.51	15.25	1.48	14.38			
10/20/96															
12:00 AM	3620	29.24	18.24	19.94	4 44	16.41	2.99	16.17	2.51	15.26	1.49	14.38	1.76	144	Adjust rate
12:20 AM	3640	29.21	18.21	19.96	4 46	16.42	3.00	16.18	2.52	15.26	1.49	14.37			
12:40 AM	3660	29.36	18.36	19.97	4,47	16.42	3.00	16.18	2.52	15.26	1.49	14.37			
01:00 AM	3680	29.08	18.08	19.95	4.45	16.42	3.00	16.19	2.53	15.26	1.49	14.37	1.77	144	
01:20 AM	3700	29.10	18.10	19.95	4.45	16.42	3.00	16.19	2.53	15.26	1.49	14.37			
01:40 AM	3720	29.03	18.03	19.95	4.45	16.42	3.00	16.19	2.53	15.27	1.50	14.37			
02:00 AM	3740	29.08	18.08	19.96	4.46	16.43	3.01	16.19	2.53	15.27	1.50	14.37	1.77	144	
02:20 AM	3760	29.12	18.12	19.96	4.46	16.43	3.01	16.20	2.54	15.27	1.50	14.37			
02:40 AM	3780	29.03	18.03	19.97	4.47	16.44	3.02	16.20	2.54	15.28	1.51	14.37			
03:00 AM	3800	29.09	18.09	19.97	4.47	16.44	3.02	16.21	2.55	15.28	1.51	14.37	1.77	144	
03:20 AM	3820	29.02	18.02	19.98	4.48	16.45	3.03	16.21	2.55	15.28	1.51	14.37			
03:40 AM	3840	29.09	18.09	19.98	4.48	16.45	3.03	16.21	2.55	15.29	1.52	14.38			
04:00 AM	3860	29.07	18.07	19.98	4.48	16.45	3.03	16.21	2.55	15.29	1.52	14.38	1.77	144	
04:20 AM	3880	29.07	18.07	19.98	4.48	16.45	3.03	16.22	2.56	15.29	1.52	14.38			

Ground-Water Investigation in the Embarras River Valley for E J Water Corporation
Test/Production Well 11 II Four-day Aquifer Test: October 17-21, 1996

Date/ Hour	Elapsed time (min)	Well 11 Depth to water (ft)	Well 11 Observed drwdwn (ft)	Test Boring 4 Depth to water (ft)	Test Boring 4 Observed drwdwn (ft)	Observation Well 1 Depth to water (ft)	Observation Well 1 Observed drwdwn (ft)	Observation Well 2 Depth to water (ft)	Observation Well 2 Observed drwdwn (ft)	Observation Well 3 Depth to water (ft)	Observation Well 3 Observed drwdwn (ft)	Approx barometric pressure (psia)	Piezometer head (ft)	Pumping rate (gpm)	Remarks
04:40 AM	3900	29.09	18.09	19.98	4.48	16.45	3.03	16.22	2.56	15.29	1.52	14.38			
05:00 AM	3920	29.06	18.06	19.99	4.49	16.46	3.04	16.22	2.56	15.29	1.52	14.38	1.77	144	
05:20 AM	3940	29.02	18.02	19.99	4.49	16.46	3.04	16.23	2.57	15.30	1.53	14.38			
05:40 AM	3960	29.05	18.05	19.99	4.49	16.47	3.05	16.23	2.57	15.30	1.53	14.38			
06:00 AM	3980	28.97	17.97	20.00	4.50	16.47	3.05	16.23	2.57	15.30	1.53	14.38	1.77	144	
06:20 AM	4000	29.02	18.02	20.01	4.51	16.47	3.05	16.23	2.57	15.30	1.53	14.38			
06:40 AM	4020	29.13	18.13	20.00	4.50	16.47	3.05	16.23	2.57	15.31	1.54	14.38			
07:00 AM	4040	29.09	18.09	20.01	4.51	16.48	3.06	16.24	2.58	15.31	1.54	14.38	1.78	144	
07:20 AM	4060	29.14	18.14	20.01	4.51	16.48	3.06	16.24	2.58	15.31	1.54	14.38			
07:40 AM	4080	29.20	18.20	20.02	4.52	16.48	3.06	16.24	2.58	15.31	1.54	14.38			
08:00 AM	4100	29.26	18.26	20.03	4.53	16.49	3.07	16.25	2.59	15.32	1.55	14.38	1.78	144	Adjust rate
08:20 AM	4120	29.40	18.40	20.03	4.53	16.50	3.08	16.26	2.60	15.32	1.55	14.39			
08:40 AM	4140	29.33	18.33	20.03	4.53	16.49	3.07	16.25	2.59	15.32	1.55	14.39			
09:00 AM	4160	29.19	18.19	20.01	4.51	16.50	3.08	16.25	2.59	15.32	1.55	14.40	1.77	144	
09:20 AM	4180	29.15	18.15	20.01	4.51	16.49	3.07	16.25	2.59	15.32	1.55	14.40			
09:40 AM	4200	29.15	18.15	20.01	4.51	16.49	3.07	16.25	2.59	15.32	1.55	14.40			
10:00 AM	4220	29.37	18.37	20.01	4.51	16.50	3.08	16.26	2.60	15.33	1.56	14.41	1.76	144	
10:20 AM	4240	29.41	18.41	20.01	4.51	16.49	3.07	16.25	2.59	15.32	1.55	14.40			
10:40 AM	4260	29.36	18.36	20.01	4.51	16.49	3.07	16.24	2.58	15.31	1.54	14.41			
11:00 AM	4280	29.40	18.40	20.01	4.51	16.50	3.08	16.26	2.60	15.32	1.55	14.41	1.76	144	
11:20 AM	4300	29.58	18.58	20.01	4.51	16.50	3.08	16.25	2.59	15.33	1.56	14.41			
11:40 AM	4320	29.46	18.46	20.01	4.51	16.50	3.08	16.26	2.60	15.33	1.56	14.41			
12:00 PM	4340	29.58	18.58	20.01	4.51	16.50	3.08	16.26	2.60	15.33	1.56	14.41	1.76	144	
12:20 PM	4360	29.56	18.56	20.01	4.51	16.49	3.07	16.25	2.59	15.32	1.55	14.41			
12:40 PM	4380	29.56	18.56	20.00	4.50	16.50	3.08	16.26	2.60	15.33	1.56	14.41			
01:00 PM	4400	29.68	18.68	20.01	4.51	16.50	3.08	16.26	2.60	15.33	1.56	14.41	1.76	144	
01:20 PM	4420	29.62	18.62	20.01	4.51	16.49	3.07	16.24	2.58	15.31	1.54	14.41			
01:40 PM	4440	29.67	18.67	20.01	4.51	16.50	3.08	16.26	2.60	15.33	1.56	14.40			
02:00 PM	4460	29.74	18.74	20.02	4.52	16.49	3.07	16.25	2.59	15.33	1.56	14.41	1.77	144	
02:20 PM	4480	29.52	18.52	20.01	4.51	16.50	3.08	16.26	2.60	15.33	1.56	14.40			
02:40 PM	4500	29.62	18.62	20.01	4.51	16.51	3.08	16.27	2.61	15.34	1.57	14.40			
03:00 PM	4520	29.83	18.83	20.02	4.52	16.50	3.08	16.26	2.60	15.34	1.57	14.40	1.77	144	
03:20 PM	4540	29.78	18.78	20.01	4.51	16.51	3.08	16.27	2.61	15.34	1.57	14.40			
03:40 PM	4560	29.80	18.80	20.02	4.52	16.50	3.08	16.26	2.60	15.33	1.56	14.39			
04:00 PM	4580	29.82	18.82	20.03	4.53	16.51	3.09	16.27	2.61	15.34	1.57	14.40	1.77	144	
04:20 PM	4600	29.72	18.72	20.03	4.53	16.51	3.09	16.27	2.61	15.35	1.58	14.40			
04:40 PM	4620	29.68	18.68	20.03	4.53	16.51	3.09	16.27	2.61	15.34	1.57	14.40			
05:00 PM	4640	29.66	18.66	20.03	4.53	16.52	3.10	16.28	2.62	15.35	1.58	14.40	1.78	144	
05:20 PM	4660	29.62	18.62	20.03	4.53	16.52	3.10	16.28	2.62	15.35	1.58	14.40			
05:40 PM	4680	29.58	18.58	20.04	4.54	16.52	3.10	16.28	2.62	15.35	1.58	14.40			
06:00 PM	4700	29.48	18.48	20.04	4.54	16.52	3.10	16.28	2.62	15.35	1.58	14.39	1.77	144	
06:20 PM	4720	29.53	18.53	20.04	4.54	16.52	3.10	16.28	2.62	15.35	1.58	14.39			
06:40 PM	4740	29.36	18.36	20.04	4.54	16.53	3.11	16.29	2.63	15.36	1.58	14.39			
07:00 PM	4760	29.39	18.39	20.04	4.54	16.53	3.11	16.29	2.63	15.36	1.59	14.39	1.77	144	
07:20 PM	4780	29.30	18.30	20.04	4.54	16.53	3.11	16.29	2.63	15.36	1.59	14.39			
07:40 PM	4800	29.25	18.25	20.04	4.54	16.54	3.12	16.30	2.64	15.36	1.59	14.39			
08:00 PM	4820	29.27	18.27	20.04	4.54	16.54	3.12	16.30	2.64	15.37	1.60	14.39	1.76	144	
08:20 PM	4840	29.20	18.20	20.04	4.54	16.54	3.12	16.30	2.64	15.37	1.60	14.39			

Ground-Water Investigation in the Embarras River Valley for E J Water Corporation
Test/Production Well 11 II Four-day Aquifer Test: October 17-21, 1996

		Well 11		Test Boring 4		Observation Well 1		Observation Well 2		Observation Well 3					
Date / Hour	Elapsed lime (min)	Depth to water (ft)	Observed drwdwn (ft)	Depth to water (ft)	Observed drwdwn (ft)	Depth to water (ft)	Observed drwdwn (ft)	Depth to water (ft)	Observed drwdwn (ft)	Depth to water (ft)	Observed drwdwn (ft)	Approx barometric pressure (psia)	Piezometer head (ft)	Pumping rate (gpm)	Remarks
08:40 PM	4860	29.25	18.25	20.04	4.54	16.54	3.12	16.30	2.64	15.37	1.60	14.39			
09:00 PM	4880	29.36	18.36	20.04	4.54	16.54	3.12	16.30	2.64	15.37	1.60	14.38	1.77	144	
09:20 PM	4900	29.33	18.33	20.05	4.55	16.54	3.12	16.30	2.64	15.37	1.60	14.39			
09:40 PM	4920	29.33	18.33	20.05	4.55	16.54	3.12	16.30	2.64	15.37	1.60	14.39			
10:00 PM	4940	29.32	18.32	20.06	4.56	16.55	3.13	16.31	2.65	15.38	1.61	14.39	1.76	144	
10:20 PM	4960	29.37	18.37	20.08	4.58	16.56	3.14	16.32	2.66	15.39	1.62	14.40			
10:40 PM	4980	29.41	18.41	20.08	4.58	16.56	3.14	16.32	2.66	15.39	1.62	14.40			
11:00 PM	5000	29.33	18.33	20.08	4.58	16.56	3.14	16.32	2.66	15.39	1.62	14.40	1.76	144	
11:20 PM	5020	29.39	18.39	20.08	4.58	16.56	3.14	16.32	2.66	15.39	1.62	14.40			
11:40 PM	5040	29.46	18.46	20.08	4.58	16.56	3.14	16.32	2.66	15.39	1.62	14.40			
10/21/96															
12:00 AM	5060	29.46	18.46	20.07	4.57	16.56	3.14	16.32	2.66	15.39	1.62	14.40	1.76	144	
12:20 AM	5080	29.46	18.46	20.08	4.58	16.56	3.14	16.32	2.66	15.39	1.62	14.40			
12:40 AM	5100	29.40	18.40	20.08	4.58	16.56	3.14	16.32	2.66	15.39	1.62	14.39			
01:00 AM	5120	29.39	18.39	20.07	4.57	16.56	3.14	16.32	2.66	15.38	1.61	14.39	1.76	144	
01:20 AM	5140	29.50	18.50	20.08	4.58	16.56	3.14	16.32	2.66	15.39	1.62	14.39			
01:40 AM	5160	29.49	18.49	20.07	4.57	16.56	3.14	16.32	2.66	15.39	1.62	14.38			
02:00 AM	5180	29.37	18.37	20.08	4.58	16.56	3.14	16.32	2.66	15.39	1.62	14.38	1.77	144	
02:20 AM	5200	29.48	18.48	20.08	4.58	16.57	3.15	16.33	2.67	15.40	1.63	14.39			
02:40 AM	5220	29.49	18.49	20.08	4.58	16.57	3.15	16.33	2.67	15.39	1.62	14.38			
03:00 AM	5240	29.52	18.52	20.08	4.58	16.57	3.15	16.33	2.67	15.40	1.63	14.38	1.77	144	
03:20 AM	5260	29.43	18.43	20.09	4.59	16.57	3.15	16.33	2.67	15.40	1.63	14.38			
03:40 AM	5280	29.46	18.46	20.09	4.59	16.58	3.16	16.33	2.67	15.40	1.63	14.39			
04:00 AM	5300	29.51	18.51	20.09	4.59	16.58	3.16	16.34	2.68	15.40	1.63	14.39	1.77	144	
04:20 AM	5320	29.52	18.52	20.10	4.60	16.58	3.16	16.34	2.68	15.41	1.63	14.39			
04:40 AM	5340	29.51	18.51	20.10	4.60	16.58	3.16	16.34	2.68	15.40	1.63	14.38			
05:00 AM	5360	29.55	18.55	20.09	4.59	16.58	3.16	16.34	2.68	15.40	1.63	14.38	1.77	144	
05:20 AM	5380	29.48	18.48	20.10	4.60	16.59	3.17	16.34	2.68	15.41	1.63	14.38			
05:40 AM	5400	29.50	18.50	20.11	4.61	16.59	3.17	16.35	2.69	15.41	1.64	14.39			
06:00 AM	5420	29.57	18.57	20.11	4.61	16.60	3.18	16.35	2.69	15.42	1.64	14.39	1.77	144	
06:20 AM	5440	29.45	18.45	20.11	4.61	16.60	3.18	16.36	2.70	15.42	1.65	14.39			
06:40 AM	5460	29.56	18.56	20.13	4.63	16.60	3.18	16.36	2.70	15.42	1.65	14.40			
07:00 AM	5480	29.59	18.59	20.13	4.63	16.61	3.19	16.36	2.70	15.42	1.65	14.40	1.78	144	
07:20 AM	5500	29.40	18.40	20.13	4.63	16.61	3.19	16.37	2.71	15.43	1.66	14.40			
07:40 AM	5520	29.52	18.52	20.13	4.63	16.61	3.19	16.37	2.71	15.43	1.66	14.41			
08:00 AM	5540	29.40	18.40	20.13	4.63	16.62	3.20	16.37	2.71	15.43	1.66	14.41	1.77	144	
08:20 AM	5560	29.47	18.47	20.13	4.63	16.62	3.20	16.37	2.71	15.43	1.66	14.41			
08:40 AM	5580	29.45	18.45	20.13	4.63	16.62	3.20	16.37	2.71	15.43	1.66	14.41			
09:00 AM	5600	29.45	18.45	20.13	4.63	16.61	3.19	16.37	2.71	15.43	1.66	14.41	1.77	144	
09:20 AM	5620	29.54	18.54	20.13	4.63	16.62	3.20	16.37	2.71	15.43	1.66	14.41			
09:40 AM	5640	29.66	18.66	20.13	4.63	16.61	3.19	16.36	2.70	15.43	1.66	14.40			
10:00 AM	5660	29.58	18.58	20.13	4.63	16.62	3.20	16.37	2.71	15.43	1.66	14.40	1.79	144	
10:20 AM	5680	29.68	18.68	20.13	4.63	16.62	3.20	16.37	2.71	15.43	1.66	14.40			
10:40 AM	5700	29.70	18.70	20.13	4.63	16.62	3.20	16.37	2.71	15.43	1.66	14.40			
10:59 AM															Pump OFF;
11:00 AM	5720	16.32		19.40		16.52		16.35		15.43		14.40			Generator quit
11:20 AM	5740	12.86		17.99		15.96		15.88		15.34		14.41			
11:40 AM	5760	12.62		17.79		15.80		15.73		15.26		14.41			

Ground-Water Investigation in the Embarras River Valley for E J Water Corporation
Test/Production Well 11 II Four-day Aquifer Test:: October 17-21, 1996

Date/ Hour	Elapsed lime (min)	Well 11 Depth to water (ft)	Well 11 Observed drwdwn (ft)	Test Boring 4 Depth to water (ft)	Test Boring 4 Observed drwdwn (ft)	Observation Well 1 Depth to water (ft)	Observation Well 1 Observed drwdwn (ft)	Observation Well 2 Depth to water (ft)	Observation Well 2 Observed drwdwn (ft)	Observation Well 3 Depth to water (ft)	Observation Well 3 Observed drwdwn (ft)	Approx barometric pressure (psia)	Piezometer head (ft)	Pumping rate (gpm)	Remarks
12:00 PM	5780	12.49		17.67		15.69		15.64		15.21		14.42			
12:20 PM	5800	12.45		17.58		15.61		15.56		15.16		14.41			
12:40 PM	5820	12.39		17.51		15.54		15.51		15.13		14.41			
01:00 PM	5840	12.34		17.45		15.48		15.45		15.10		14.40			
01:20 PM	5860	12.36		17.39		15.42		15.40		15.06		14.39			
01:40 PM	5880	12.35		17.33		15.36		15.35		15.03		14.39			
02:00 PM	5900	12.37		17.29		15.32		15.31		15.01		14.38			River stage = 0.26'
02:19 PM	5919	12.81													Steel tape
02:20 PM	5920	12.34		17.25		15.27		15.28		14.99		14.39			
02:21 PM						15.22									Steel tape
02:23 PM				17.27											Steel tape
02:25 PM								15.37							Steel tape
02:28 PM										15.02					Steel tape

Notes:

Approx = approximate
drwdwn = drawdown
ft = feet
gpm = gallons per minute
min = minutes
psia = pounds per square inch absolute

Appendix F.

Chemical Analyses of Water Samples: Production Well 11

ILLINOIS
DEPARTMENT OF
NATURAL
RESOURCES

Illinois State Water Survey

Main Office • 2204 Griffith Drive • Champaign, IL 61820-7495 • *Tel (217) 333-2210- Fax (217) 333-6540*
Peoria Office • P.O. Box 697 • Peoria. IL 61652-0697 • *Tel (309) 671-3196- Fax (309) 671-3106*

SWS

December 6, 1996

Mr. Delbert Mundt
President
EJ Water Corporation
P.O. Box 8
Dieterich, IL 62424

Dear Mr. Mundt:

We are enclosing a copy of the partial analyses made on samples of water collected October 15 and 18, 1996, from the 51 foot deep Well No. 11 owned by EJ Water Corporation, in Jasper County.

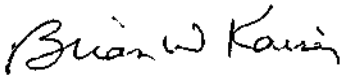
The iron and manganese contents of this water are at a level which can result in the staining of porcelain and laundry.

The analyses show the untreated samples to be moderately mineralized and moderately hard. The hardness in these samples is sufficient to cause the formation of a moderate amount of soft scale in boilers and hot water heaters and to consume a moderate amount of soap if used for washing or laundry.

None of the parameters tested appear unusual for Illinois ground water, nor do they exceed primary drinking water standards.

If we can be of further assistance, please let us hear from you.

Very truly yours,



Brian W. Kaiser
Associate Chemist
217/333-9234

Enclosures as stated

cc: Mr. Pat Milano, Milano and Grunloh Engineers, Inc.
Mr. James A. Speth, Speth Plumbing, Inc.
Mr. Ellis Sanderson, ISWS
IEPA (2)

ILLINOIS DEPARTMENT OF NATURAL RESOURCES

Illinois State Water Survey

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Peoria Office • P.O. Box 697 • Peoria IL 61652-0697 • *Tel (309) 671-3196- Fax (309) 671-3106*

SWS

WATER SAMPLE DATA
LABORATORY SAMPLE NUMBER: 229760

SOURCE: WELL NO. 11
OWNER: E. J. WATER CORP.
LOCATION: JASPER CO.
COUNTY: JASPER TOWNSHIP: 07N RANGE: 09E SECTION: 10.5F
DATE COLLECTED: 10/15/1996 DATE RECEIVED: 10/21/1996
WELL DEPTH (Ft.): 51.0 TEMPERATURE REPORTED (F): 56.3
TREATMENT: NONE
COMMENTS: SAMPLE COLLECTED AFTER PUMPING AT 100 TO 180 GPM FOR 140 MIN. TURBIDITY DUE TO OXIDIZED IRON.

PARAMETER:	mg/L	PARAMETER:	mg/L
Iron (Total Fe):	3.67	Fluoride (F):	0.2
Manganese (Mn):	0.43	Chloride (Cl):	17.8
Calcium (Ca):	60.5	Sulfate (S04):	46.2
Magnesium (Mg):	22.5	Nitrate (N03-N):	< 0.02
Sodium (Na):	37.5		
Aluminum (Al):	< 0.02		
Barium (Ba):	0.23		
Beryllium (Be):	< 0.003		
Boron (B):	< 0.13		
Chromium (Cr):	< 0.007		
Copper (Cu):	< 0.01		
Nickel (Ni):	< 0.031		
Zinc (Zn):	< 0.02		
Turbidity(Lab, NTU):	33.6	Alkalinity (CaC03):	297
Color (PCU):	10	Hardness (as CaC03):	243
pH (Lab):	7.8	Total Dissolved Minerals:	352
Odor:	NONE		

< = Below detection limit (i.e. <1.0 = less than 1.0 mg/L)
mg/L = milligrams per liter mg/L x 0.0584 = grains per gallon
uS/cm = microsiemens per centimeter
ND = Not determined/Information not available

IEPA Certified Environmental Laboratory, Number 100202

Lauren F. Sievers (BWC)

Analysts: Lauren F. Sievers
ASSOCiate ChemiSt

Daniel L. Webb
Associate Chemist

Primed on recycled paper

ILLINOIS DEPARTMENT OF NATURAL RESOURCES

Illinois State Water Survey

Main Office • 2204 Griffith Drive • Champaign, IL 61820-7495 • *Tel (217) 333-2210* • *Fax (217) 333-6540*
Peoria Office • P.O. Box 697 • Peoria. IL 61652-0697 • *Tel (309) 671-3196' Fax (309) 671-3106*

SWS

WATER SAMPLE DATA
LABORATORY SAMPLE NUMBER: 229761

SOURCE: WELL NO. 11
OWNER: E. J. WATER CORP.
LOCATION: JASPER CO.
COUNTY: JASPER TOWNSHIP: 07N RANGE: 09E SECTION: 10.5F
DATE COLLECTED: 10/18/1996 DATE RECEIVED: 10/21/1996
WELL DEPTH (Ft.): 51.0 TEMPERATURE REPORTED (F): ND
TREATMENT: NONE
COMMENTS: SAMPLE COLLECTED AFTER PUMPING AT 142 GPM FOR 1760 MIN. TURBIDITY DUE TO OXIDIZED IRON.

PARAMETER:	mg/L	PARAMETER:	mg/L
Iron (Total Fe):	3.61	Fluoride (F):	0.1
Manganese (Mn):	0.30	Chloride (Cl):	15.5
Calcium (Ca):	61.3	Sulfate (S04):	50.8
Magnesium (Mg):	22.7	Nitrate (N03-N):	< 0.02
Sodium (Na):	30.9		
Aluminum (Al):	< 0.02		
Barium (Ba):	0.21		
Beryllium (Be):	< 0.003		
Boron (B):	< 0.13		
Chromium (Cr):	< 0.007		
Copper (Cu):	< 0.01		
Nickel (Ni):	< 0.031		
Zinc (Zn):	< 0.02		
Turbidity(Lab, NTU):	37.4	Alkalinity (CaC03):	271
Color (PCU):	10	Hardness (as CaC03):	246
pH (Lab):	7.8	Total Dissolved Minerals:	339
Odor:	NONE		

< = Below detection limit (i.e. <1.0 = less than 1.0 mg/L)
mg/L = milligrams per liter mg/L x 0.0584 = grains per gallon
uS/cm = microsiemens per centimeter
ND = Not determined/Information not available

IEPA Certified Environmental Laboratory, Number 100202

Lauren F. Sievers

Analysts: Lauren F. Sievers
ASSOCiate Chemist

Daniel L. Webb
Associate Chemist

Appendix G.

Ground-Water Levels and Barometric Pressure Data

Ground-Water Investigation in the Embarras River Valley
for the E J Water Corporation
Ground-Water Levels and Barometric Pressure Data, October 4-17. 1996

Date/ Hour	*Elapsed time (min)*	*Approx barometric pressure (psia)*	*Approx barometric pressure (ft of water)*	*Observation Well 1 **	
				Depth to water (ft)	*Water elevation (ft msl)***
10/04/96					
01:30 PM	0	14.67	33.84	15.56	481.44
02:30 PM	60	14.65	33.80	14.49	482.51
03:30 PM	120	14.64	33.78	13.81	483.19
04:30 PM	180	14.64	33.77	13.57	483.43
05:30 PM	240	14.63	33.76	13.45	483.56
06:30 PM	300	14.63	33.74	13.36	483.64
07:30 PM	360	14.62	33.72	13.30	483.70
08:30 PM	420	14.60	33.69	13.26	483.74
09:30 PM	480	14.60	33.67	13.23	483.78
10:30 PM	540	14.59	33.67	13.20	483.80
11:30 PM	600	14.58	33.64	13.17	483.83
10/05/96					
12:30 AM	660	14.58	33.64	13.15	483.85
01:30 AM	720	14.59	33.65	13.14	483.86
02:30 AM	780	14.59	33.65	13.13	483.87
03:30 AM	840	14.58	33.64	13.11	483.89
04:30 AM	900	14.58	33.64	13.11	483.89
05:30 AM	960	14.58	33.64	13.10	483.90
06:30 AM	1020	14.58	33.64	13.09	483.91
07:30 AM	1080	14.58	33.64	13.09	483.91
08:30 AM	1140	14.60	33.67	13.10	483.90
09:30 AM	1200	14.62	33.72	13.10	483.90
10:30 AM	1260	14.63	33.76	13.09	483.91
11:30 AM	1320	14.64	33.77	13.07	483.93
12:30 PM	1380	14.63	33.76	13.05	483.95
01:30 PM	1440	14.62	33.74	13.03	483.97
02:30 PM	1500	14.62	33.72	13.00	484.00
03:30 PM	1560	14.61	33.71	13.00	484.00
04:30 PM	1620	14.61	33.71	13.00	484.00
05:30 PM	1680	14.61	33.71	13.01	483.99
06:30 PM	1740	14.60	33.69	13.01	483.99
07:30 PM	1800	14.59	33.67	13.01	483.99
08:30 PM	1860	14.58	33.64	13.01	483.99
09:30 PM	1920	14.58	33.62	13.02	483.98
10:30 PM	1980	14.57	33.61	13.02	483.98
11:30 PM	2040	14.57	33.61	13.02	483.98
10/06/96					
12:30 AM	2100	14.56	33.59	13.01	483.99
01:30 AM	2160	14.56	33.59	13.01	483.99
02:30 AM	2220	14.56	33.58	13.02	483.98
03:30 AM	2280	14.55	33.57	13.01	483.99
04:30 AM	2340	14.55	33.56	13.01	483.99
05:30 AM	2400	14.55	33.56	13.01	483.99
06:30 AM	2460	14.55	33.56	13.01	483.99
07:30 AM	2520	14.55	33.56	13.01	483.99
08:30 AM	2580	14.56	33.58	13.02	483.98
09:30 AM	2640	14.57	33.61	13.03	483.97
10:30 AM	2700	14.58	33.63	13.03	483.97
11:30 AM	2760	14.58	33.64	13.01	483.99
12:30 PM	2820	14.58	33.64	13.00	484.00
01:30 PM	2880	14.57	33.62	12.98	484.02
02:30 PM	2940	14.57	33.60	12.96	484.04
03:30 PM	3000	14.56	33.59	12.96	484.04
04:30 PM	3060	14.55	33.57	12.96	484.04
05:30 PM	3120	14.55	33.56	12.96	484.04
06:30 PM	3180	14.54	33.54	12.96	484.04
07:30 PM	3240	14.53	33.51	12.97	484.03
08:30 PM	3300	14.51	33.47	12.97	484.03
09:30 PM	3360	14.50	33.44	12.97	484.03
10:30 PM	3420	14.49	33.43	12.98	484.02
11:30 PM	3480	14.48	33.41	12.97	484.03
12:30 AM	3540	14.47	33.38	12.96	484.04

Ground-Water Investigation in the Embarras River Valley
for the E J Water Corporation
Ground-Water Levels and Barometric Pressure Data, October 4-17,1996

Date/ Hour	*Elapsed time (min)*	*Approx barometric pressure (psia)*	*Approx barometric pressure (ft of water)*	*Observation Well 1* Depth to water (ft)*	*Water elevation (ftmsl)***
10/07/96					
01:30 AM	3600	14.46	33.36	12.96	484.04
02:30 AM	3660	14.46	33.35	12.96	484.04
03:30 AM	3720	14.45	33.34	12.96	484.04
04:30 AM	3780	14.45	33.33	12.96	484.04
05:30 AM	3840	14.45	33.33	12.97	484.03
06:30 AM	3900	14.44	33.32	12.97	484.03
07:30 AM	3960	14.44	33.30	12.97	484.03
08:30 AM	4020	14.44	33.32	12.98	484.02
09:30 AM	4080	14.46	33.37	12.98	484.02
10:30 AM	4140	14.47	33.39	12.97	484.03
11:30 AM	4200	14.48	33.39	12.97	484.03
12:30 PM	4260	14.47	33.39	12.96	484.04
01:30 PM	4320	14.46	33.36	12.93	484.07
02:30 PM	4380	14.45	33.35	12.93	484.07
03:30 PM	4440	14.45	33.34	12.93	484.07
04:30 PM	4500	14.45	33.33	12.93	484.07
05:30 PM	4560	14.44	33.31	12.93	484.07
06:30 PM	4620	14.43	33.28	12.93	484.07
07:30 PM	4680	14.42	33.27	12.95	484.05
08:30 PM	4740	14.42	33.28	12.97	484.03
09:30 PM	4800	14.42	33.27	12.98	484.02
10:30 PM	4860	14.42	33.26	12.98	484.02
11:30 PM	4920	14.41	33.25	12.99	484.02
10/08/96					
12:30 AM	4980	14.40	33.22	12.97	484.03
01:30 AM	5040	14.39	33.20	12.97	484.03
02:30 AM	5100	14.38	33.18	12.96	484.04
03:30 AM	5160	14.38	33.17	12.96	484.04
04:30 AM	5220	14.37	33.16	12.96	484.04
05:30 AM	5280	14.37	33.16	12.97	484.03
06:30 AM	5340	14.37	33.15	12.97	484.03
07:30 AM	5400	14.37	33.15	12.98	484.02
08:30 AM	5460	14.37	33.15	12.98	484.02
09:30 AM	5520	14.37	33.16	12.99	484.02
10:30 AM	5580	14.37	33.15	12.99	484.01
11:30 AM	5640	14.37	33.15	12.98	484.02
12:30 PM	5700	14.37	33.14	14.15	482.85
01:30 PM	5760	14.36	33.12	13.91	483.09
02:30 PM	5820	14.35	33.10	15.20	481.80
03:30 PM	5880	14.35	33.10	14.78	482.22
04:30 PM	5940	14.35	33.10	13.78	483.22
05:30 PM	6000	14.35	33.10	13.55	483.45
06:30 PM	6060	14.35	33.11	13.43	483.57
07:30 PM	6120	14.35	33.11	13.37	483.63
08:30 PM	6180	14.36	33.13	13.32	483.68
09:30 PM	6240	14.36	33.13	13.29	483.71
10:30 PM	6300	14.36	33.13	13.26	483.74
11:30 PM	6360	14.36	33.14	13.24	483.76
10/09/96					
12:30 AM	6420	14.36	33.13	13.22	483.78
01:30 AM	6480	14.36	33.12	13.20	483.80
02:30 AM	6540	14.35	33.11	13.19	483.81
03:30 AM	6600	14.35	33.10	13.17	483.83
04:30 AM	6660	14.35	33.10	13.17	483.83
05:30 AM	6720	14.35	33.11	13.17	483.83
06:30 AM	6780	14.36	33.12	13.17	483.83
07:30 AM	6840	14.36	33.13	13.17	483.83
08:30 AM	6900	14.38	33.16	13.18	483.82
09:30 AM	6960	14.39	33.20	13.18	483.82
10:30 AM	7020	14.40	33.22	14.74	482.26
11:30 AM	7080	14.41	33.25	15.17	481.83
12:30 PM	7140	14.42	33.26	15.39	481.61
01:30 PM	7200	14.42	33.26	15.52	481.48

Ground-Water Investigation in the Embarras River Valley
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Ground-Water Levels and Barometric Pressure Data, October 4-17, 1996

Date/ Hour	*Elapsed time (min)*	*Approx barometric pressure (psia)*	*Approx barometric pressure (ft of water)*	*Observation Well 1** *Depth to water (ft)*	*Water elevation (ft msl)***
02:30 PM	7260	14.41	33.25	15.62	481.38
03:30 PM	7320	14.42	33.26	15.71	481.29
04:30 PM	7380	14.42	33.26	15.79	481.21
05:30 PM	7440	14.42	33.26	15.85	481.15
06:30 PM	7500	14.42	33.26	14.75	482.25
07:30 PM	7560	14.42	33.26	14.33	482.67
08:30 PM	7620	14.42	33.26	14.11	482.89
09:30 PM	7680	14.43	33.28	13.97	483.03
10:30 PM	7740	14.43	33.29	13.86	483.14
11:30 PM	7800	14.43	33.28	13.78	483.23
10/10/96					
12:30 AM	7860	14.43	33.29	13.72	483.28
01:30 AM	7920	14.43	33.29	13.66	483.34
02:30 AM	7980	14.43	33.29	13.62	483.38
03:30 AM	8040	14.43	33.29	13.59	483.41
04:30 AM	8100	14.44	33.30	13.56	483.44
05:30 AM	8160	14.44	33.32	13.54	483.46
06:30 AM	8220	14.45	33.34	13.52	483.48
07:30 AM	8280	14.46	33.35	13.51	483.49
08:30 AM	8340	14.47	33.39	13.51	483.50
09:30 AM	8400	14.49	33.43	13.50	483.50
10:30 AM	8460	14.51	33.47	13.49	483.51
11:30 AM	8520	14.52	33.50	13.48	483.52
12:30 PM	8580	14.53	33.52	13.46	483.54
01:30 PM	8640	14.53	33.52	13.44	483.56
02:30 PM	8700	14.54	33.53	13.43	483.57
03:30 PM	8760	14.54	33.55	13.43	483.57
04:30 PM	8820	14.55	33.56	13.43	483.57
05:30 PM	8880	14.55	33.56	13.42	483.58
06:30 PM	8940	14.55	33.56	13.41	483.59
07:30 PM	9000	14.56	33.58	13.42	483.58
08:30 PM	9060	14.56	33.59	13.41	483.59
09:30 PM	9120	14.56	33.59	13.41	483.59
10:30 PM	9180	14.57	33.60	13.41	483.59
11:30 PM	9240	14.57	33.61	13.40	483.60
10/11/96					
12:30 AM	9300	14.56	33.60	13.40	483.61
01:30 AM	9360	14.56	33.59	13.39	483.62
02:30 AM	9420	14.56	33.59	13.38	483.62
03:30 AM	9480	14.55	33.57	13.37	483.63
04:30 AM	9540	14.55	33.58	13.37	483.63
05:30 AM	9600	14.56	33.59	13.37	483.63
06:30 AM	9660	14.56	33.60	13.37	483.63
07:30 AM	9720	14.57	33.60	13.37	483.63
08:30 AM	9780	14.58	33.63	13.38	483.62
09:30 AM	9840	14.60	33.69	13.37	483.63
10:30 AM	9900	14.62	33.72	13.36	483.64
11:30 AM	9960	14.62	33.72	13.34	483.66
12:30 PM	10020	14.61	33.71	13.32	483.68
01:30 PM	10080	14.60	33.68	13.29	483.71
02:30 PM	10140	14.59	33.65	13.27	483.73
03:30 PM	10200	14.58	33.63	13.26	483.74
04:30 PM	10260	14.57	33.61	13.25	483.75
05:30 PM	10320	14.56	33.59	13.25	483.75
06:30 PM	10380	14.55	33.57	13.24	483.76
07:30 PM	10440	14.54	33.55	13.25	483.75
08:30 PM	10500	14.53	33.52	13.25	483.75
09:30 PM	10560	14.52	33.50	13.25	483.75
10:30 PM	10620	14.52	33.49	13.25	483.75
11:30 PM	10680	14.52	33.49	13.25	483.75
10/12/96					
12:30 AM	10740	14.51	33.48	13.25	483.75
01:30 AM	10800	14.52	33.49	13.26	483.74
02:30 AM	10860	14.51	33.48	13.25	483.75

Ground-Water Investigation in the Embarras River Valley
for the E J Water Corporation
Ground-Water Levels and Barometric Pressure Data, October 4-17.,1996

Date/ Hour	Elapsed time (min)	Approx barometric pressure (psia)	Approx barometric-pressure (ft of water)	Observation Well 1* Depth to water if')	Water elevation (ft msl)**
03:30 AM	10920	14.52	33.50	13.26	483.74
04:30 AM	10980	14.52	33.49	13.25	483.75
05:30 AM	11040	14.53	33.51	13.27	483.73
06:30 AM	11100	14.53	33.52	13.27	483.73
07:30 AM	11160	14.53	33.53	13.27	483.73
08:30 AM	11220	14.54	33.55	13.28	483.72
09:30 AM	11280	14.56	33.58	13.28	483.72
10:30 AM	11340	14.57	33.60	13.27	483.73
11:30 AM	11400	14.57	33.62	13.26	483.74
12:30 PM	11460	14.57	33.61	13.25	483.75
01:30 PM	11520	14.56	33.58	13.23	483.77
02:30 PM	11580	14.55	33.56	13.21	483.79
03:30 PM	11640	14.54	33.55	13.21	483.79
04:30 PM	11700	14.54	33.54	13.21	483.79
05:30 PM	11760	14.54	33.53	13.21	483.79
06:30 PM	11820	14.53	33.52	13.22	483.78
07:30 PM	11880	14.53	33.52	13.23	483.77
08:30 PM	11940	14.53	33.51	13.24	483.76
09:30 PM	12000	14.52	33.50	13.24	483.76
10:30 PM	12060	14.52	33.50	13.25	483.75
11:30 PM	12120	14.52	33.50	13.25	483.75
10/13/96					
12:30 AM	12180	14.52	33.50	13.26	483.74
01:30 AM	12240	14.52	33.49	13.26	483.74
02:30 AM	12300	14.52	33.49	13.26	483.74
03:30 AM	12360	14.52	33.50	13.26	483.74
04:30 AM	12420	14.53	33.51	13.26	483.74
05:30 AM	12480	14.53	33.52	13.27	483.73
06:30 AM	12540	14.53	33.53	13.28	483.72
07:30 AM	12600	14.53	33.52	13.28	483.72
08:30 AM	12660	14.53	33.53	13.28	483.72
09:30 AM	12720	14.55	33.56	13.28	483.73
10:30 AM	12780	14.55	33.58	13.27	483.73
11:30 AM	12840	14.56	33.59	13.26	483.74
12:30 PM	12900	14.55	33.57	13.24	483.76
01:30 PM	12960	14.54	33.54	13.22	483.78
02:30 PM	13020	14.53	33.52	13.21	483.79
03:30 PM	13080	14.52	33.50	13.20	483.80
04:30 PM	13140	14.52	33.50	13.20	483.80
05:30 PM	13200	14.52	33.49	13.21	483.79
06:30 PM	13260	14.51	33.47	13.22	483.79
07:30 PM	13320	14.51	33.48	13.23	483.77
08:30 PM	13380	14.51	33.47	13.24	483.76
09:30 PM	13440	14.50	33.45	13.25	483.75
10:30 PM	13500	14.50	33.45	13.26	483.74
11:30 PM	13560	14.51	33.47	13.27	483.73
10/14/96					
12:30 AM	13620	14.50	33.46	13.27	483.73
01:30 AM	13680	14.50	33.45	13.27	483.73
02:30 AM	13740	14.50	33.44	13.27	483.73
03:30 AM	13800	14.50	33.45	13.27	483.73
04:30 AM	13860	14.50	33.45	13.28	483.73
05:30 AM	13920	14.51	33.47	13.28	483.72
06:30 AM	13980	14.51	33.47	13.29	483.71
07:30 AM	14040	14.51	33.47	13.29	483.71
08:30 AM	14100	14.51	33.48	13.30	483.70
09:30 AM	14160	14.53	33.51	13.30	483.70
10:30 AM	14220	14.54	33.55	13.30	483.70
11:30 AM	14280	14.55	33.56	13.29	483.71
12:30 PM	14340	14.55	33.56	13.28	483.72
01:30 PM	14400	14.54	33.54	13.26	483.74
02:30 PM	14460	14.53	33.52	13.25	483.75
03:30 PM	14520	14.53	33.52	13.25	483.75
04:30 PM	14580	14.53	33.51	13.25	483.75

Ground-Water Investigation in the Embarras River Valley
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Ground-Water Levels and Barometric Pressure Data,, October 4-17,1996

Date/ Hour	*Elapsed time (min)*	*Approx barometric pressure (psia)*	*Approx barometric pressure (ft of water)*	*Observation Well 1* Depth to water (ft)*	*Water elevation (ft msl)***
05:30 PM	14640	14.52	33.50	13.25	483.75
06:30 PM	14700	14.52	33.49	13.25	483.75
07:30 PM	14760	14.51	33.47	13.27	483.73
08:30 PM	14820	14.50	33.45	13.27	483.73
09:30 PM	14880	14.50	33.44	13.28	483.72
10:30 PM	14940	14.50	33.44	13.29	483.71
11:30 PM	15000	14.49	33.44	13.29	483.71
10/15/96					
12:30 AM	15060	14.49	33.42	13.29	483.71
01:30 AM	15120	14.49	33.42	13.29	483.71
02:30 AM	15180	14.49	33.42	13.29	483.71
03:30 AM	15240	14.48	33.41	13.29	483.71
04:30 AM	15300	14.48	33.41	13.30	483.70
05:30 AM	15360	14.48	33.40	13.30	483.70
06:30 AM	15420	14.48	33.41	13.31	483.69
07:30 AM	15480	14.48	33.40	13.31	483.69
08:30 AM	15540	14.49	33.42	13.32	483.68
09:30 AM	15600	14.50	33.46		497.00
10:30 AM	15660	14.51	33.47	Step Test	497.00
11:30 AM	15720	14.52	33.49	in progress	497.00
12:30 PM	15780	14.51	33.47		497.00
01:30 PM	15840	14.50	33.45	*14.307	497.00
02:30 PM	15900	14.49	33.42	*13.819	497.00
03:30 PM	15960	14.48	33.41	13.66	483.34
04:30 PM	16020	14.48	33.40	13.58	483.42
05:30 PM	16080	. 14.48	33.39	13.52	483.48
06:30 PM	16140	14.47	33.37	13.49	483.51
07:30 PM	16200	14.46	33.35	13.47	483.53
08:30 PM	16260	14.45	33.33	13.45	483.55
09:30 PM	16320	14.44	33.32	13.44	483.56
10:30 PM	16380	14.44	33.31	13.42	483.58
11:30 PM	16440	14.43	33.29	13.41	483.59
10/16/96					
12:30 AM	16500	14.43	33.29	13.40	483.61
01:30 AM	16560	14.43	33.29	13.39	483.62
02:30 AM	16620	14.43	33.29	13.38	483.62
03:30 AM	16680	14.42	33.27	13.37	483.63
04:30 AM	16740	14.42	33.26	13.36	483.64
05:30 AM	16800	14.42	33.26	13.36	483.64
06:30 AM	16860	14.41	33.25	13.36	483.64
07:30 AM	16920	14.42	33.26	13.36	483.64
08:30 AM	16980	14.43	33.29	13.36	483.64
09:30 AM	17040	14.44	33.32	13.36	483.64
10:30 AM	17100	14.45	33.33	13.35	483.65
11:30 AM	17160	14.46	33.35	13.35	483.65
12:30 PM	17220	14.45	33.35	13.34	483.66
01:30 PM	17280	14.44	33.32	13.33	483.68
02:30 PM	17340	14.44	33.30	13.31	483.69
03:30 PM	17400	14.43	33.29	13.30	483.70
04:30 PM	17460	14.43	33.28	13.30	483.70
05:30 PM	17520	14.43	33.29	13.30	483.70
06:30 PM	17580	14.42	33.27	13.30	483.70
07:30 PM	17640	14.41	33.24	13.30	483.70
08:30 PM	17700	14.40	33.22	13.30	483.70
09:30 PM	17760	14.40	33.21	13.30	483.70
10:30 PM	17820	14.39	33.20	13.31	483.69
11:30 PM	17880	14.39	33.19	13.30	483.70
10/17/96					
12:30 AM	17940	14.38	33.18	13.30	483.70
01:30 AM	18000	14.38	33.16	13.30	483.70
02:30 AM	18060	14.37	33.14	13.29	483.71
03:30 AM	18120	14.36	33.13	13.29	483.71
04:30 AM	18180	14.35	33.11	13.29	483.71
05:30 AM	18240	14.35	33.11	13.29	483.71

Ground-Water Investigation in the Embarras River Valley
for the E J Water Corporation
Ground-Water Levels and Barometric Pressure Data, October 4-17 1996

Date/ Hour	*Elapsed time (min)*	*Approx barometric pressure (psia)*	*Approx barometric pressure (ft of water)*	*Observation Well 1* Depth to water (ft)*	*Water elevation (ft msl)***
06:30 AM	18300	14.35	33.11	13.29	483.71
07:30 AM	18360	14.35	33.11	13.29	483.71
08:30 AM	18420	14.35	33.11	13.29	483.71
09:30 AM	18480	14.36	33.13	13.28	483.72

Notes:

*Early ground-water levels recovering from aborted step test
**Ground elevation = 494.0 assumed
Approx = approximate
ft = feet
ft msl = feet above mean sea level
min = minutes
psia = pounds per square inch absolute

Appendix H.

Sieve Data and Design Recommendations for Production Well 12

Sieve Data for Aquifer Samples

E **J** Water Company, Inc

Test Hole for Production Well 12
Drilled by Speth Plumbing, Inc.
Drilled May, 1997
Samples sieved by State Geological Survey, June 1997

Depth	*Sample*	*U.S. Sieves, #/opening size, in mm*											
(ft)	*Weight*	*#5*	*#7*	*#10*	*#14*	*#18*	*#25*	*#35*	*#45*	*#60*	*#80*	*#120*	*Pan*
	(g)	*4.00*	*2.80*	*2.00*	*1.400*	*1.000*	*0.710*	*0.500*	*0.355*	*0.250*	*0.177*	*0.125*	
		(Cumulative Percent Retained)											
		Dry sieve results of analyses run on material wet sieved on 0.125 mm sieve											
40 - 45	103.9*	4.3	-	33.5	-	60.0	63.3	66.1	75.2	91.5	97.7	99.7	100.0
45 - 50	108.4*	4.6	-	13.1	-	21.4	23.4	29.4	52.9	86.3	97.2	99.9	100.1

*Original sample weight: 40-45 ft = 121.1 g; 45-50 ft = 118.8 g

Observation Well 3 (500 ft)
Drilled by Speth Plumbing, Inc.
Drilled June 25, 1996
Samples sieved by State Geological Survey, June 1997

Depth	*Sample*	*U.S. Sieves, #/opening size, in mm*											
(ft)	*Weight*	*#5*	*#7*	*#10*	*#14*	*#18*	*#25*	*#35*	*#45*	*#60*	*#80*	*#120*	*Pan*
	(g)	*4.00*	*2.80*	*2.00*	*1.400*	*1.000*	*0.710*	*0.500*	*0.355*	*0.250*	*0.177*	*0.125*	
		(Cumulative Percent Retained)											
35 - 40	119.5	-	-	19.2	-	26.4	29.0	33.7	50.3	82.0	94.9	98.3	100.0
		Dry sieve results of analyses run on material wet sieved on 0.125 mm sieve											
45 - 50	180.6*	14.6	-	58.5	75.9	86.9	90.5	92.2	93.8	-	98.1	-	100.0

*Original sample weight: 45-50 ft = 207.0 g

Production Well 12
Northern Gravel Company, Well Pack No. 3, placed in annulus from 25 to 50 feet
Sample sieved by Illinois State Geological Survey, August 1997

Sample	*U.S. Sieves, #/ opening size, in mm*					
Weight	*#4*	*#5*	*#6*	*#7*	*#10*	*Pan*
(g)	*4.75*	*4.00*	*3.35*	*2.80*	*2.00*	
	(Cumulative Percent Retained)					
132.4	0.0	7.8	40.1	76.8	98.0	100.0

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Illinois State Water Survey

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SWS

June 2, 1997

Mr. Pat Milano
Milano and Grunloh Engineers, Inc.
211 North Third Street
P.O. Box 897
Effingham, IL 62401

Dear Mr. Milano:

This letter is to confirm our telephone conversation of May 29 and June 2, 1997, regarding a suggestion for the well screen and gravel pack for the proposed new production Well 12 for the E J Water Corporation. Well 12 is to be located near Observation Well (OW) 3 about 500 feet north of Well 11. We have examined the sieve analysis data for the aquifer samples from OW 3 (about 500 feet north of Well 11) and for the samples from a test hole drilled May 12, 1997, about 30 feet east of OW 3. OW 3 is located approximately 870 ft South and 2735 ft East of the NW corner and the test hole is located about 870 ft South and 2765 ft East of the NW corner, Section 10, T.7 N., R.9 E., Jasper County. We understand that a pumping rate of about 200 gallons per minute (gpm) is desired from a 12-inch diameter gravel packed production well at this site. Whether the well can be safely operated at this pumping rate is to be evaluated with a 24-hour aquifer test.

The sieve analysis data shows a distinct difference in texture in the bottom 10 feet of aquifer material between the two holes about 30 feet apart. According to Ross Brower at the State Geological Survey, such textural changes within short distances are not unusual in the depositional environment that was present in this bottomland area. We also note that the driller's log for the test hole (drilled May 12, 1997) shows a layer of clay/mud from 37 to 40 feet which is not present at OW 3. This could present problems in developing an efficient well at the test hole spot.

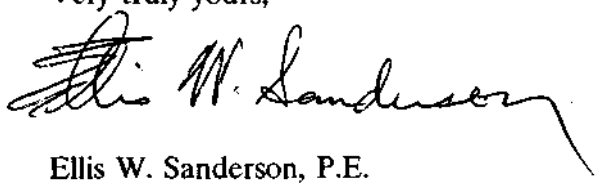
If Well 12 is drilled at the test hole spot, the sieve analysis data, the desired production rate, and our well design criteria indicate that a gravel packed well design is warranted. Based on the grain size distribution of the sand and gravel aquifer sample from depths of 45 to 51 feet, a gravel pack with a grain size of about 1.1 to 1.8 mm would be ideal for this sand and gravel aquifer. If material from Northern Gravel Company is used, our information suggests their No. 1 material is about 1.3 to 2.2 mm in size and should be satisfactory for use. This information should be verified directly from the company. A well screen with a slot size of 0.055-inch (55 slot) can be used with this gravel pack. A 10-foot length of the specified 12-inch diameter well screen set between depths of about 41 to 51 feet will be adequate for the desired production rate of 200 gpm. The gravel pack should extend at least 1 to 2 feet above the top of the well screen. If significantly finer-grained material is present above a depth of 40 feet, care must be taken to fill the remainder of the annular space between the bore hole and the well casing with material suitable to prevent vertical migration of this finer material. A bore hole diameter of 22 to 28 inches is suggested.

If Well 12 is drilled at OW 3 (about 30 feet west of the test hole), the grain size distribution of the sand and gravel aquifer sample from depths of 45 to 50 feet and our well design criteria suggests that a gravel pack with a grain size as large as about 6.9 to 11.5 mm could be used with this sand and gravel aquifer. If material from Northern Gravel Company is used, our information suggests their ⅛- x ¼-inch material is about 3.5 to 6.2 mm in size and should be satisfactory for use. This information should be verified directly from the company. A well screen with a slot size of 0.125-inch (125 slot) can be used with the ⅛- x ¼-inch gravel pack. A 10-foot length of the specified 12-inch diameter well screen set between depths of about 41 to 51 feet will be adequate for the desired production rate of 200 gpm. The gravel pack should extend at least 1 to 2 feet above the top of the well screen. If significantly finer-grained material is present above a depth of 40 feet, care must be taken to fill the remainder of the annular space between the bore hole and the well casing with material suitable to prevent vertical migration of this finer material. A bore hole diameter of 22 to 28 inches is suggested.

Because of the disparity between these two well designs and with the restriction of needing to offset Well 12 from the property line about 6 feet (to about 4-5 feet east of OW 3), we suggest consideration be given to placing Well 12 as close to OW 3 as physically possible. To allow for possible changes in texture (even within 5 feet of OW 3) we believe that a compromise well design is reasonable and offers good chance for success. The following suggestion allows for some change (smaller grain size) in formation texture but should improve the chances for a well to provide the desired 200-gpm pumping rate over that offered at the test hole spot. Our suggestion is to use a gravel pack similar to Northern Gravel pack material No. 2 which is about 1.7 to 3.2 mm in size or Northern Gravel pack material No. 3 which is about 1.8 to 4.5 mm in size. A well screen with a slot size of 0.080-inch (80 slot) can be used with these gravel packs. A 10-foot length of well screen set between depths of about 41 to 51 feet is recommended.

Please do not hesitate to contact us if you have any questions about this matter.

Very truly yours,



Ellis W. Sanderson, P.E.
Senior Engineer
Office of Ground-Water Resources
Evaluation and Management
Phone: (217) 333-0235

cc: IEPA (2)
Mr. Jim Speth, Speth Plumbing, Inc.
Mr. David Klitzing, E J Water Corporation
A. Visocky
N. Bhowmik
B. Bennett

ILLINOIS
DEPARTMENT OF
NATURAL
RESOURCES

ILLINOIS STATE GEOLOGICAL SURVEY

Natural Resources Building
615 East Peabody Drive
Champaign, IL 61820-6964
217/333-4747
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June 16, 1997

Mr. Daniel Klitzing, General Manager
E J Corp
P.O. Box 8
Dietrich, IL 61424

Re: E J Water Well #12 and Obs Well 500 sieving

Dear Mr. Klitzing:

At your request delivered through Mr. Ellis W. Sanderson of the State Water Survey, sieve analyses were run on selected rotary drill samples from a test hole constructed at the site of proposed Well #12 and from nearby Observation Well 500 which was drilled in 1996 during the construction of Well #11. The results of these analyses are reported on the enclosed data sheets and graphics. The location of proposed Well #12 was reported to be 870 feet from the north line and 2765 feet from the west line of Section 10, T.7N., R.9E. Jasper County, Illinois. Observation Well 500 lies 30 feet west of the proposed well site. Drilling was done by Speth, Incorporated of Allendale, Illinois.

The Rose Hill 7-1/2 minute topographic quadrangle map and information supplied by the State Water Survey report an estimated elevation of 497 feet above msl at Observation Well 500. A similar elevation is expected at the site of Well #12. Both sites are situated in the valley of the Embarras River.

A summary of the analysis results is given on the first page of the enclosures. The results are reported as cumulative percent of sample retained on the designated mesh sieves. Invoice #138 is enclosed to cover the cost of running the analysis of 4 samples in the ISGS Geotechnical Laboratory. The analysis results have already been directed to the State Water Survey for preparation of a design recommendation for the proposed test well.

The sample intervals selected for analysis were visually inspected and a brief summary description is given below for these intervals and adjacent unsieved intervals.

WELL #12 Samples

Sample description	sample depth interval (in feet)
Brown (heavy stain) very coarse sand to fine gravel, some/little medium gravel, little coarse sand, trace clay fragments in parts of sample; estimated median grain size greater than 0.100 inch (2.5 mm)	25-30
Yellowish brown very coarse sand to fine gravel, some/little medium to coarse sand; silty; some suggestion of thin beds of silt/clay in sample; estimated median grain size of 0.05-0.07 inch (1.3-1.7 mm)	30-35
Tannish gray fine to medium sand, some coarse sand, little to trace very coarse sand and fine gravel, a few pebbles medium gravel, silty [these materials represent 40 percent of sample]; 60 percent of sample is light gray silt/clay with abundant coarse sand to fine gravel, some/little medium gravel	35-40
Gray with streak of tannish gray fine to medium sand, some coarse sand to fine gravel, trace medium gravel; silty; part of sample was coarse sand to fine gravel (includes more than 15% clayey silt); analysis determined median-grain size of 0.60 inch (1.48 mm) after 14.2 percent of fines removed by wet sieving through 0.125 mm sieve	40-45
Slightly tannish gray fine to medium sand, very abundant very coarse sand and fine gravel with streaks of silty clay 1/8 to 7/16-inch thick armored with very coarse sand and fine gravel; silty clay streaks tend to be lighter gray in color; analysis determined median grain size of approximately 0.014 inch (0.36 mm) after sample was wet sieved through 0.125 mm sieve; wet sieving removed 8.7% of sample	45-50
Gray sticky clay (shale), some silt, some intermixed medium to very coarse sand, little gravel	50-53

Obs Well 500 Samples

Sample description	sample depth interval (in feet)
Yellowish brown very coarse sand to fine gravel, little medium gravel, little coarse sand, little fine to medium sand, a few thin streaks of light grayish brown clayey silt; estimated median grain size of 0.060 to 0.070 inch (1.5 to 1.7mm)	30-35
Light grayish brown fine to medium sand, little/some coarse to very coarse sand, some fine gravel, little/trace medium gravel, a few fragments of light colored silt/very fine sand and clayey silt; analysis determined median grain size of about 0.014-inch (0.36mm)	35-40
Light brown very coarse sand to fine gravel, trace medium gravel, some coarse silt to medium sand; little/some fragments of coarse silt/very fine sand; estimated median grain size of 0.065 to 0.075-inch (1.6 mm to 1.8mm)	40-45
Brown very coarse sand to fine gravel, little fine to coarse sand, silty; analysis determined median grain size of 0.094 inch (2.3 mm) after wet sieving removed nearly 13% of original sample through 0.125 mm sieve	45-50

These samples contain variable and often large quantities of finer-grained materials that may cause problem(s) with developing the size of well supply desired at the proposed well site. The valley bottom deposits in this area of the Embarras Valley can be expected to change rapidly over very short distances. Caution is recommended during well construction to minimize smearing of fine-grained material over the face of the coarser-grained, water-yielding horizons penetrated by the well bore. Fairly extensive well development may be necessary to efficiently produce a sediment-free water supply from the proposed well.

Please feel free to call if there are any questions related to the analysis results or to the geologic conditions affecting completion of the proposed test well for the village.

Sincerely,

Ross D. Brower RDB.
Staff Geologist

Enclosures:

cc: E. W. Sanderson, SWS
IEPA-PWS (2)
T.C.Young

Mr. Daniel Klitzing. General Manager
Attachment - data summary
June 16, 1997

SUMMARY Sieve Analysis Results				
E. J. Water Well #12 (proposed production well) 870' NL, 2265' WL. Section 10, T.7N.. R.9E., Jasper County also Observation Well 500 (30 feet west of Well #12)				
IS6S Geotech Lab Job No. 958				
File No. Sample Interval		Well #12		Obs. Well 500
		11002 40-45'	11003 45-50'	11004 35-40'	11005 45-50'
wet sieved thru 0.125 mm sieve		14.2% *	8.7% *	spl not wet sieved	12.8% *
Dry sieve results of analyses run of material retained on 0.125 mm					
Sieves Inch	Used mm				
0.0157	4.00	4.3%	4.6%	–	14.6%
0.079	2.00	33.5%	13.1	19.2%	58.5
0.056	1.41	-	-	-	75.9
0.039	1.00	60.0	21.4	26.4	86.9
0.028	0.707	63.3	23.4	29.0	90.5
0.020	0.500	66.1	29.4	33.7	92.2
0.014	0.354	75.2	52.9	50.3	93.8
0.010	0.250	91.5	86.3	82.0	-
0.007	0.177	97.7	97.2	94.9	98.1
0.005	0.012	99.7	99.9	98.3	-
0.0035	0.008	-	-	99.0	99.8
PAN		100.0	100.1	100.0	100.0

* Percent of original sample passing through 0.125 mm sieve by wet sieving. This material was not included in the calculations made for dry sieved portion of three of the samples 135

Appendix I.

Step Test: Production Well 12

Ground-Water Investigation in the Embarras River Valley for E J Water Corporation
Production Well 12 II Step Test: July 31,1997

Date/ Hour	*Elapsed time (min)*	*Well 12 depth to water* ***(ft)***	*W12 Piez * adj depth to water* ***(ft)***	*Piezometer head* ***(ft)***	*Pumping rate (gpnt)*	*Remarks*
07/31/97						
09:46 AM	0		8.68			Dropline measurement
09:47 AM	0	8.68				Dropline measurement
10:25 AM	0	8.68	8.69			Data logging started
10:26 AM	1	8.69	8.69			Water level trend
10:27 AM	2	8.69	8.70			
10:28 AM	3	8.68	8.68			
10:29 AM	4	8.68	8.68			
10:30 AM	5	8.68	8.68			
10:31 AM	6	8.67	8.66			
10:32 AM	7	8.67	8.66			
10:33 AM	8	8.67	8.66			
10:34 AM	9	8.67	8.66			
10:35 AM	10	8.68	8.67			
10:36 AM	11	8.68	8.68			
10:37 AM	12	8.68	8.68			
10:38 AM	13	8.68	8.68			
10:39 AM	14	8.68	8.68			
10:40 AM	15	8.68	8.67			
10:41 AM	16	8.67	8.66			
10:42 AM	17	8.67	8.66			
10:43 AM	18	8.68	8.68			
10:44 AM	19	8.68	8.68			
10:45 AM	20	8.67	8.66			
10:46 AM	21	8.66	8.64			
10:47 AM	22	8.68	8.68			
10:48 AM	23	8.68	8.68			
10:49 AM	24	8.67	8.67			
10:50 AM	25	8.67	8.66			
10:51 AM	26	8.68	8.67			
10:52 AM	27	8.67	8.67			
10:53 AM	28	8.67	8.66			
10:54 AM	29	8.67	8.65			
10:55 AM	30	8.67	8.66			
10:56 AM	31	8.67	8.67			
10:57 AM	32	8.67	8.67			
10:58 AM	33	8.67	8.67			
10:59 AM	34	8.67	8.67			
11:00 AM	35	8.66	8.64			
11:01 AM	36	8.66	8.64			
11:02 AM	37	8.67	8.66			
11:03 AM	38	8.67	8.68			
11:04 AM	39	8.67	8.68			
11:05 AM	40	8.67	8.67			
11:06 AM	41	8.66	8.65			
11:07 AM	42	8.66	8.65			
11:08 AM	43	8.67	8.67			
11:09 AM	44	8.66	8.66			
11:10 AM	45	8.67	8.66			
11:11 AM	46	8.67	8.66			
11:12 AM	47	8.67	8.67			
11:13 AM	48	8.66	8.64			
11:14 AM	49	8.66	8.64			
11:15 AM	50	8.66	8.65			
11:16AM	51	8.66	8.65			
11:17 AM	52	8.67	8.67			
11:18AM	53	8.66	8.66			
11:19 AM	54	8.67	8.69			
11:20 AM	55	8.65	8.65			
11:21 AM	56	8.65	8.64			
11:22 AM	57	8.66	8.65			
11:23 AM	58	8.65	8.66			
11:24 AM	59	8.64	8.65			
11:25 AM	60	8.64	8.65			
11:26 AM	61	8.64	8.63			

Ground-Water Investigation in the Embarras River Valley for E J Water Corporation
Production Well 12 II Step Test: July 31,1997

Date/ Hour	*Elapsed time (min)*	*Well 12 depth to water (ft)*	*W12 Piez * adj depth to water (ft)*	*Piezometer head (ft)*	*Pumping rate (gpm)*	*Remarks*
11:27 AM	62	8.64	8.65			
11:28 AM	63	8.65	8.66			
11:29 AM	64	8.64	8.65			
11:30 AM	65	8.64	8.65			
11:31 AM	66	8.64	8.64			
11:32 AM	67	8.64	8.65			
11:33 AM	68	8.64	8.66			
11:34 AM	69	8.65	8.67			
11:35 AM	70	8.64	8.65			
11:36 AM	71	8.64	8.65			
11:37 AM	72	8.65	8.66			
11:38 AM	73	8.64	8.64			
11:39 AM	74	8.64	8.65			
11:40 AM	75	8.64	8.65			
11:41 AM	76	8.63	8.63			
11:42 AM	77	8.65	8.66			
11:43 AM	78	8.65	8.68			
11:44 AM	79	8.64	8.65			
11:45 AM	80	8.63	8.64			
11:46 AM	81	8.64	8.64			
11:47 AM	82	8.64	8.65			
11:48 AM	83	8.64	8.66			
11:49 AM	84	8.65	8.68			
11:50 AM	85	8.63	8.65			
11:51 AM	86	8.64	8.64			
11:52 AM	87	8.63	8.63			
11:53 AM	88	8.63	8.64			
11:54 AM	89	8.64	8.64			
11:55 AM	90	8.63	8.63			
11:56 AM	91	8.63	8.63			
11:57 AM	92	8.63	8.64			
11:58 AM	93	8.64	8.65			
11:59 AM	94	8.63	8.63			
12:00 PM	0	23.65	19.88			Pump ON
12:01 PM	1	21.27	21.21	1.35	200	Step 1
12:02 PM	2	22.39	22.35			
12:03 PM	3	22.85	22.74	1.33		Adjust rate
12:04 PM	4	23.20	23.14	1.35	200	
12:05 PM	5	23.54	23.46			
12:06 PM	6	23.71	23.63			
12:07 PM	7	23.80	23.72			
12:08 PM	8	23.91	23.85			
12:09 PM	9	23.98	23.92			
12:10 PM	10	24.03	23.96			
12:11 PM	11	24.13	24.05	1.35	200	
12:12 PM	12	24.17	24.07			
12:13 PM	13	24.21	24.13			
12:14 PM	14	24.28	24.19			
12:15 PM	15	24.31	24.21	1.35	200	
12:16 PM	16	24.36	24.27			
12:17 PM	17	24.41	24.31			
12:18 PM	18	24.44	24.38			
12:19 PM	19	24.47	24.42			
12:20 PM	20	24.50	24.42			
12:21 PM	21	24.53	24.48			
12:22 PM	22	24.54	24.49			
12:23 PM	23	24.59	24.53	1.35	200	
12:24 PM	24	24.60	24.52			
12:25 PM	25	24.62	24.53			
12:26 PM	26	24.58	24.49			
12:27 PM	27	24.63	24.54			
12:28 PM	28	24.61	24.56			
12:29 PM	29	24.68	24.56			
12:30 PM	30	24.73	24.67	1.35	200	Increase rate

Ground-Water Investigation in the Embarras River Valley for E J Water Corporation
Production Well 12 II Step Test: July 31, 1997

Date/ Hour	*Elapsed time (min)*	*Well 12 depth to water* (ft)	*W12 Piez * adj depth to water* (ft)	*Piezometer head* (ft)	*Pumping rate (Spm)*	*Remarks*
12:31 PM	1	26.00	25.93	1.61	220	Step 2
12:32 PM	2	26.17	26.10			
12:33 PM	3	26.26	26.17			
12:34 PM	4	26.28	26.18			
12:35 PM	5	26.35	26.26			
12:36 PM	6	26.39	26.33	1.61	220	
12:37 PM	7	26.43	26.36			
12:38 PM	8	26.45	26.38			
12:39 PM	9	26.46	26.40			
12:40 PM	10	26.48	26.39			
12:41 PM	11	26.50	26.43			
12:42 PM	12	26.52	26.44	1.62	220	
12:43 PM	13	26.55	26.46			
12:44 PM	14	26.54	26.46			
12:45 PM	15	26.57	26.49			
12:46 PM	16	26.59	26.46			
12:47 PM	17	26.59	26.50			
12:48 PM	18	26.62	26.54	1.61	220	
12:49 PM	19	26.63	26.55			
12:50 PM	20	26.64	26.57			
12:51 PM	21	26.65	26.61			
12:52 PM	22	26.67	26.60			
12:53 PM	23	26.68	26.58			
12:54 PM	24	26.70	26.61			
12:55 PM	25	26.70	26.62	1.61	220	
12:56 PM	26	26.71	26.65			
12:57 PM	27	26.74	26.67			
12:58 PM	28	26.72	26.64			
12:59 PM	29	26.75	26.63			
01:00 PM	30	26.77	26.69	1.61	220	Increase rate
01:01 PM	1	28.08	28.01	1.92	240	Step 3
01:02 PM	2	28.29	28.17			
01:03 PM	3	28.36	28.26			
01:04 PM	4	28.39	28.32			
01:05 PM	5	28.41	28.31	1.92	240	
01:06 PM	6	28.46	28.35			
01:07 PM	7	28.45	28.37			
01:08 PM	8	28.47	28.37	1.92	240	
01:09 PM	9	28.49	28.41			
01:10PM	10	28.49	28.40			
01:11 PM	11	28.51	28.41			
01:12 PM	12	28.53	28.46			
01:13 PM	13	28.56	28.48			
01:14 PM	14	28.59	28.49			
01:15 PM	15	28.57	28.49	1.92	240	
01:16 PM	16	28.61	28.49			
01:17 PM	17	28.60	28.49			
01:18 PM	18	28.62	28.49			
01:19 PM	19	28.64	28.54			
01:20 PM	20	28.65	28.59			
01:21 PM	21	28.65	28.59	1.92	240	
01:22 PM	22	28.66	28.56			
01:23 PM	23	28.64	28.53			
01:24 PM	24	28.64	28.51			
01:25 PM	25	28.69	28.54			
01:26 PM	26	28.69	28.59			
01:27 PM	27	28.70	28.61			
01:28 PM	28	28.74	28.62			
01:29 PM	29	28.72	28.63			
01:30 PM	30	28.74	28.64	1.92	240	Increase rate
01:31 PM	1	29.98	29.90	2.23	260	Step 4
01:32 PM	2	30.13	30.03			
01:33 PM	3	30.19	30.09			
01:34 PM	4	30.22	30.13	2.22		Adjust rate

Ground-Water Investigation in the Embarras River Valley for E J Water Corporation
Production Well 12 II Step Test: July 31, 1997

Date/ Hour	*Elapsed time (min)*	*Well 12 depth to water (ft)*	*WI2 Piez * adj depth to water (ft)*	*Piezometer head (ft)*	*Pumping rate (gpm)*	*Remarks*
01:35 PM	5	30.31	30.22	2.23	260	
01:36 PM	6	30.35	30.23			
01:37 PM	7	30.35	30.24			
01:38 PM	8	30.35	30.25			
01:39 PM	9	30.36	30.27			
01:40 PM	10	30.36	30.27			
01:41 PM	11	30.39	30.32			
01:42 PM	12	30.40	30.31	2.23	260	
01:43 PM	13	30.42	30.32			
01:44 PM	14	30.45	30.34			
01:45 PM	15	30.44	30.34			
01:46 PM	16	30.43	30.34			
01:47 PM	17	30.45	30.33	2.23	260	
01:48 PM	18	30.49	30.34			
01:49 PM	19	30.50	30.38			
01:50 PM	20	30.50	30.42			
01:51 PM	21	30.49	30.42			
01:52 PM	22	30.51	30.43			
01:53 PM	23	30.50	30.43			
01:54 PM	24	30.51	30.42	2.23	260	
01:55 PM	25	30.51	30.45			
01:56 PM	26	30.52	30.42			
01:57 PM	27	30.52	30.43			
01:58 PM	28	30.53	30.40			
01:59 PM	29	30.53	30.39			
02:00 PM	30	30.53	30.42	2.23	260	Increase rate
02:01 PM	1	31.90	31.79			Step 5
02:02 PM	2	32.04	31.93			
02:03 PM	3	32.03	31.92			
02:04 PM	4	32.08	31.95	2.57		
02:05 PM	5	32.13	32.03			
02:06 PM	6	32.19	32.09	2.58	280	
02:07 PM	7	32.20	32.08			
02:08 PM	8	32.21	32.10			
02:09 PM	9	32.21	32.13			
02:10 PM	10	32.23	32.12	2.58	280	
02:11 PM	11	32.24	32.15			
02:12 PM	12	32.25	32.17			
02:13 PM	13	32.27	32.17			
02:14 PM	14	32.28	32.18			
02:15 PM	15	32.29	32.20			
02:16 PM	16	32.28	32.21			
02:17 PM	17	32.30	32.20			
02:18 PM	18	32.32	32.21	2.58	280	
02:19 PM	19	32.33	32.23			
02:20 PM	20	32.33	32.22			
02:21 PM	21	32.34	32.21			
02:22 PM	22	32.35	32.23			
02:23 PM	23	32.36	32.26			
02:24 PM	24	32.36	32.24	2.58	280	
02:25 PM	25	32.38	32.26			
02:26 PM	26	32.40	32.30			
02:27 PM	27	32.38	32.28			
02:28 PM	28	32.38	32.29	2.58	280	
02:29 PM	29	32.40	32.29			
02:30 PM	30	32.41	32.31	2.58	280	End of step test

Notes: * Piezometer is installed in approximate middle of gravel pack outside well screen.
Adjusted depths to water are from same total organic compounds reference point as Well 12.
Adj = adjusted
ft = feet
gpm = gallons per minute
min = minutes

Appendix J.

24-Hour Aquifer Test: Production Well 12

Ground-Water Investigation in the Embarras River Valley for E J Water Corporat on
Production Well 12 II 24-hr Aquifer Test: August 5-6,1997

Date/ Hour	Elapsed time (min)	Well 12 Depth to water (ft)	Well 12 Observed drwdwn (ft)	W12 Piez* Adj depth to water (ft)	Well II (OW) Depth to water (ft)	Well II (OW) Observed dnvdwn (ft)	Observation Well 1 Depth to water (ft)	Observation Well 1 Observed drwdwn (ft)	Observation Well 2 Depth to water (ft)	Observation Well 2 Observed drwdwn (ft)	Observation Well 3 Depth to water (ft)	Observation Well 3 Observed drwdwn (ft)	Observation Well 4 Depth to water (ft)	Observation Well 4 Observed drwdwn (ft)	Approx barometric pressure (psia)	Piezometer head (ft)	Welt 12 Pumping rate (gpm)	Remarks
08/05/97																		
10:22 AM	0						9.67											Dropline measurement
10:24 AM	0				8.08													Dropline measurement
10:25 AM	0								10.82									Dropline measurement
10:27 AM	0												10.25					Dropline measurement
10:29 AM	0	9.03																Dropline measurement
10:30 AM	0			9.02														Dropline measurement
10:31 AM	0										10.81							Dropline measurement
11:50 AM	0	9.07		9.06	8.15		9.82		10.83		10.81		10.26		14.56			Data logging started
11:52 AM	2	9.06		9.06	8.13		9.77		10.81		10.81		10.24		14.56			Water level trend
11:54 AM	4	9.06		9.05	8.12		9.74		10.80		10.81		10.22		14.56			
11:56 AM	6	9.06		9.07	8.13		9.80		10.81		10.81		10.25		14.56			
11:58 AM	8	9.06		9.08	8.12		9.77		10.81		10.81		10.25		14.56			
12:00 PM	10	9.06		9.07	8.11		9.76		10.81		10.81		10.23		14.57			
12:02 PM	12	9.05		9.05	8.10		9.71		10.78		10.81		10.21		14.56			
12:04 PM	14	9.06		9.07	8.12		9.78		10.81		10.81		10.22		14.56			
12:06 PM	16	9.03		9.04	8.07		9.67		10.75		10.81		10.17		14.56			River stage = 0.56 ft
12:08 PM	18	9.05		9.04	8.11		9.74		10.77		10.81		10.22		14.56			
12:10 PM	20	9.03		9.03	8.07		9.63		10.74		10.80		10.17		14.56			
12:12 PM	22	9.06		9.06	8.13		9.78		10.81		10.81		10.24		14.56			
12:14 PM	24	9.06		9.07	8.13		9.79		10.81		10.81		10.24		14.56			
12:16 PM	26	9.04		9.03	8.08		9.63		10.76		10.81		10.18		14.56			
12:18 PM	28	9.05		9.03	8.08		9.64		10.79		10.81		10.20		14.56			
12:20 PM	0	21.01		23.38	8.11		9.77		10.79		10.84		10.24		14.56			Pump ON
	0.008	9.76		9.57	8.11		9.78		10.81		10.86		10.24		14.56			
	0.017	1.31		4.38	8.11		9.78		10.81		10.92		10.25		14.56			
	0.025	16.45	7.40	15.09	8.11	0.00	9.78	0.01	10.81	0.02	10.87	0.06	10.24	0.02	14.56			
	0.033	12.81	3.76	12.97	8.11	0.00	9.78	0.01	10.81	0.02	10.90	0.09	10.25	0.03	14.56			
	0.042	13.42	4.37	13.42	8.11	0.00	9.78	0.01	10.81	0.02	10.93	0.12	10.25	0.03	14.56			
	0.050	13.68	4.63	13.68	8.11	0.00	9.78	0.01	10.81	0.02	10.96	0.15	10.25	0.03	14.56			
	0.058	13.96	4.91	13.95	8.12	0.01	9.78	0.01	10.81	0.02	10.99	0.18	10.26	0.04	14.56			
	0.067	14.21	5.16	14.22	8.12	0.01	9.78	0.01	10.81	0.02	11.03	0.22	10.26	0.04	14.56			
	0.075	14.47	5.42	14.49	8.11	0.00	9.78	0.01	10.81	0.02	11.06	0.25	10.27	0.05	14.56			
	0.083	14.70	5.65	14.73	8.11	0.00	9.78	0.00	10.81	0.02	11.10	0.29	10.28	0.05	14.56			
	0.092	14.93	5.88	14.97	8.11	0.00	9.78	0.00	10.81	0.02	11.14	0.33	10.28	0.06	14.56			
	0.100	15.18	6.13	15.20	8.11	0.00	9.78	0.00	10.81	0.02	11.18	0.37	10.29	0.07	14.56			
	0.108	15.40	6.35	15.42	8.11	0.00	9.78	0.01	10.81	0.02	11.22	0.41	10.30	0.08	14.56			
	0.117	15.63	6.58	15.64	8.11	0.00	9.78	0.00	10.81	0.02	11.25	0.44	10.30	0.08	14.56			
	0.125	15.83	6.78	15.86	8.11	0.00	9.78	0.00	10.81	0.02	11.29	0.48	10.31	0.09	14.56			
	0.133	16.03	6.98	16.05	8.11	0.00	9.78	0.00	10.81	0.02	11.33	0.52	10.32	0.10	14.56			
	0.142	16.22	7.17	16.21	8.11	0.00	9.77	0.00	10.81	0.02	11.36	0.55	10.33	0.11	14.56			
	0.150	16.41	7.36	16.42	8.11	0.00	9.77	0.00	10.81	0.02	11.40	0.59	10.34	0.12	14.56			
	0.158	16.59	7.54	16.60	8.11	0.00	9.77	0.00	10.81	0.02	11.43	0.62	10.35	0.13	14.56			
	0.167	16.77	7.72	16.77	8.11	0.00	9.77	-0.00	10.81	0.02	11.46	0.65	10.36	0.14	14.56			
	0.175	16.93	7.88	16.95	8.11	0.00	9.77	0.00	10.81	0.02	11.50	0.69	10.38	0.15	14.56			
	0.183	17.11	8.06	17.12	8.11	0.00	9.77	0.00	10.81	0.02	11.54	0.72	10.38	0.16	14.56			

Ground-Water Investigation in the Embarras River Valley for E J Water Corporation
Production Well 12 II 24-hr Aquifer Test: August 5-6,1997

Date/ Hour	Elapsed time (min)	Well 12 Depth to water (ft)	Well 12 Observed drwdwn (ft)	W12Piez* Adjdepth to water (ft)	Well 11 (OW) Depth to water (ft)	Well 11 (OW) Observed drwdwn (ft)	Observation Well I Depth to water (ft)	Observation Well I Observed drwdwn (ft)	Observation Well 2 Depth to water (ft)	Observation Well 2 Observed drwdwn (ft)	Observation Well 3 Depth to water (ft)	Observation Well 3 Observed drwdwn (ft)	Observation Well 4 Depth to water (ft)	Observation Well 4 Observed drwdwn (ft)	Approx barometric pressure (psia)	Piezometer head (ft)	Well 12 Pumping rate (gpm)	Remarks
	0.192	17.28	8.23	17.28	8.11	0.00	9.77	-0.00	10.81	0.02	11.57	0.76	10.39	0.17	14.56			
	0.200	17.44	8.39	17.44	8.11	0.00	9.77	-0.00	10.81	0.02	11.60	0.79	10.41	0.19	14.56			
	0.208	17.60	8.55	17.59	8.11	0.00	9.77	-0.00	10.81	0.02	11.63	0.82	10.42	0.20	14.56			
	0.217	17.74	8.69	17.74	8.11	0.00	9.77	-0.00	10.82	0.03	11.67	0.85	10.43	0.21	14.56			
	0.225	17.88	8.83	17.89	8.11	0.00	9.77	-0.00	10.81	0.02	11.69	0.88	10.44	0.22	14.56			
	0.233	18.03	8.98	18.03	8.11	0.00	9.77	-0.00	10.81	0.02	11.73	0.92	10.46	0.24	14.56			
	0.242	18.17	9.12	18.16	8.11	0.00	9.77	-0.01	10.81	0.02	11.76	0.95	10.47	0.25	14.56			
	0.250	18.28	9.23	18.27	8.11	0.00	9.77	-0.00	10.81	0.02	11.79	0.98	10.48	0.26	14.56			
	0.258	18.42	9.37	18.40	8.11	0.00	9.77	-0.01	10.82	0.03	11.82	1.01	10.49	0.27	14.56			
	0.267	18.56	9.51	18.54	8.11	0.00	9.77	-0.01	10.81	0.02	11.85	1.04	10.51	0.29	14.56			
	0.275	18.66	9.61	18.66	8.11	0.00	9.77	-0.01	10.82	0.03	11.88	1.07	10.52	0.30	14.56			
	0.283	18.79	9.74	18.78	8.11	0.00	9.77	-0.01	10.82	0.03	11.92	1.10	10.53	0.31	14.56			
	0.292	18.89	9.84	18.90	8.11	0.00	9.77	-0.01	10.82	0.03	11.94	1.13	10.54	0.32	14.56			
	0.300	19.02	9.97	19.02	8.11	0.00	9.76	-0.01	10.82	0.03	11.97	1.16	10.56	0.34	14.56			
	0.308	19.14	10.09	19.13	8.11	0.00	9.77	-0.00	10.82	0.03	11.99	1.18	10.57	0.35	14.56			
	0.317	19.23	10.18	19.23	8.11	0.00	9.76	-0.01	10.82	0.03	12.03	1.21	10.58	0.36	14.56			
	0.325	19.32	10.27	19.32	8.11	0.00	9.77	-0.01	10.82	0.03	12.05	1.24	10.59	0.37	14.56			
	0.333	19.41	10.36	19.41	8.11	0.00	9.76	-0.01	10.82	0.03	12.08	1.27	10.61	0.39	14.56			
	0.350	19.62	10.57	19.62	8.11	0.00	9.76	-0.01	10.82	0.03	12.13	1.32	10.64	0.42	14.56			
	0.367	19.79	10.74	19.79	8.11	0.00	9.76	-0.01	10.82	0.03	12.18	1.37	10.66	0.44	14.56			
	0.383	19.96	10.91	19.97	8.11	0.00	9.76	-0.01	10.82	0.03	12.24	1.43	10.69	0.47	14.56			
	0.400	20.12	11.07	20.13	8.11	0.00	9.76	-0.01	10.82	0.03	12.29	1.47	10.71	0.49	14.56			
	0.417	20.28	11.23	20.28	8.11	0.00	9.76	-0.01	10.82	0.03	12.33	1.52	10.74	0.51	14.56			
	0.433	20.43	11.38	20.42	8.11	0.00	9.76	-0.01	10.82	0.03	12.38	1.57	10.76	0.54	14.56			
	0.450	20.57	11.52	20.57	8.11	0.00	9.76	-0.01	10.82	0.03	12.42	1.61	10.79	0.56	14.56			
	0.467	20.68	11.63	20.69	8.11	0.00	9.76	-0.01	10.82	0.03	12.48	1.67	10.81	0.59	14.56			
	0.483	20.84	11.79	20.83	8.11	0.00	9.76	-0.01	10.83	0.04	12.51	1.70	10.84	0.62	14.56			
	0.500	20.95	11.90	20.95	8.12	0.01	9.73	-0.01	10.83	0.04	12.55	1.74	10.86	0.64	14.56			
	0.517	21.05	12.00	21.05	8.12	0.01	9.76.	-0.01	10.83	0.04	12.60	1.79	10.89	0.67	14.56			
	0.533	21.18	12.13	21.17	8.12	0.01	79.76	.0 01	10.83	0.04	12.64	1.83	10.91	0.69	14.56			
	0.550	21.27	12.22	21.26	8.12	0.01	9.76	-0.01	10.83	0.04	12.68	1.87	10.93	0.71	14.56			
	0.567	21.38	12.33	21.37	8.12	0.01	9.76	-001	10.83	0.04	12.72	1.91	10.96	0.74	14.56			
	0.583	21.48	12.43	21.47	8.12	0.01	9.77	-0.01	10.83	0.04	12.76	1.95	10.98	0.76	14.56			
	0.600	21.57	12.52	21.58	8.12	0.01	9.77	-0.01	10.83	0.04	12.79	1.98	11.00	0.78	14.56			
	0.617	21.67	12.62	21.66	8.12	0.01	9.77	-0.01	10.83	0.04	12.82	2.01	11.03	0.81	14.56			
	0.633	21.77	12.72	21.75	8.12	0.01	9.77	-0.01	10.83	0.04	12.87	2.06	11.05	0.83	14.56			
	0.650	21.82	12.77	21.82	8.12	0.01	9.77	-0.01	10.83	0.04	12.89	2.08	11.07	0.85	14.56			
	0.667	21.90	12.85	21.89	8.12	0.01	9.77	-0.01	10.82	0.03	12.93	2.12	11.09	0.87	14.56			
	0.683	21.97	12.92	21.97	8.12	0.01	9.77	-0.00	10.82	0.03	12.96	2.15	11.12	0.90	14.56			
	0.700	22.04	12.99	22.01	8.12	0.01	9.77	-0.00	10.82	0.03	13.00	2.19	11.14	0.92	14.56			
	0.717	22.10	13.05	22.10	8.12	0.01	9.77	-0.00	10.82	0.03	13.03	2.22	11.16	0.94	14.56			
	0.733	22.15	13.10	22.15	8.12	0.01	9.77	-0.00	10.82	0.03	13.05	2.24	11.18	0.96	14.56			
	0.750	22.22	13.17	22.21	8.12	0.01	9.77	-0.00	10.82	0.03	13.09	2.28	11.20	0.98	14.56			
	0.767	22.26	13.21	22.28	8.12	0.01	9.77	-0.00	10.82	0.03	13.12	2.30	11.22	1.00	14.56			
	0.783	22.31	13.26	22.32	8.12	0.01	9.77	-0.00	10.83	0.04	13.15	2.34	11.24	1.02	14.56			
	0.800	22.39	13.34	22.38	8.12	0.01	9.77	-0.00	10.83	0.04	13.18	2.37	11.26	1.04	14.56			

Ground-Water Investigation in the Embarras River Valley for E J Water Corporation
Production Well 12 II 24-hr Aquifer Test: ,August 5-6, 1997

Date/ Hour	Elapsed time (min)	Well 12 Depth to water (ft)	Well 12 Observed drwdwn (ft)	W12 Piez* Adj depth to water (ft)	Well // (OW) Depth to water (ft)	Well // (OW) Observed drwdwn (ft)	Observation Well 1 Depth to water (ft)	Observation Well 1 Observed drwdwn (ft)	Observation Well 2 Depth to water (ft)	Observation Well 2 Observed drwdwn (ft)	Observation Well 3 Depth to water (ft)	Observation Well 3 Observed drwdwn (ft)	Observation Well 4 Depth to water (ft)	Observation Well 4 Obsened drwdwn (ft)	Approx barometric pressure (psia)	Piezometer head (ft)	Well 12 Pumping rate (gpm)	Remarks
	0.817	22.41	13.36	22.42	8.12	0.01	9.77	-0.00	10.82	0.03	13.20	2.39	11.28	1.06	14.56			
	0.833	22.49	13.44	22.49	8.12	0.01	9.77	-0.00	10.83	0.04	13.23	2.42	11.30	1.08	14.56			
	0.850	22.51	13.46	22.52	8.12	0.01	9.77	-0.00	10.83	0.04	13.26	2.45	11.32	1.10	14.56			
	0.867	22.56	13.51	22.56	8.12	0.01	9.77	-0.00	10.83	0.04	13.28	2.47	11.34	1.12	14.56			
	0.883	22.62	13.57	22.61	8.12	0.01	9.77	-0.00	10.82	0.03	13.31	2.50	11.36	1.14	14.56			
	0.900	22.65	13.60	22.66	8.12	0.01	9.77	-0.00	10.82	0.03	13.34	2.53	11.38	1.16	14.56			
	0.917	22.69	13.64	22.68	8.12	0.01	9.77	-0.00	10.82	0.03	13.36	2.55	11.40	1.18	14.56			
	0.933	22.71	13.66	22.70	8.12	0.01	9.77	-0.00	10.83	0.04	13.38	2.57	11.42	1.19	14.56			
	0.950	22.75	13.70	22.77	8.12	0.01	9.77	-0.00	10.83	0.04	13.41	2.60	11.44	1.22	14.56			
	0.967	22.80	13.75	22.80	8.12	0.01	9.77	-0.00	10.83	0.04	13.43	2.62	11.45	1.23	14.56			
	0.983	22.84	13.79	22.83	8.12	0.01	9.77	-0.00	10.82	0.03	13.46	2.65	11.47	1.25	14.56			
12:21 PM	1.00	22.87	13.82	22.87	8.12	0.01	9.77	-0.00	10.83	0.04	13.48	2.67	11.49	1.27	14.56	1.64	222	
	1.20	23.19	14.14	23.20	8.12	0.01	9.76	-0.01	10.83	0.04	13.72	2.91	11.69	1.47	14.56			
	1.40	23.47	14.42	23.45	8.12	0.01	9.77	-0.01	10.84	0.05	13.92	3.11	11.87	1.65	14.56			
	1.60	23.66	14.61	23.64	8.12	0.01	9.77	-0.01	10.85	0.06	14.09	3.28	12.02	1.80	14.56			
	1.80	23.81	14.76	23.80	8.12	0.01	9.77	-0.00	10.86	0.07	14.24	3.43	12.15	1.93	14.56			
12:22 PM	2.00	23.95	14.90	23.96	8.12	0.01	9.77	-0.00	10.88	0.09	14.37	3.56	12.27	2.05	14.56	1.63	221	Water dirty
	2.20	24.07	15.02	24.06	8.12	0.01	9.77	-0.00	10.89	0.10	14.48	3.67	12.37	2.15	14.56			
	2.40	24.18	15.13	24.16	8.12	0.01	9.77	-0.00	10.90	0.11	14.58	3.77	12.47	2.25	14.56			
	2.60	24.25	15.20	24.26	8.12	0.01	9.77	0.00	10.91	0.12	14.68	3.87	12.56	2.34	14.56			
	2.80	24.36	15.31	24.35	8.12	0.01	9.77	-0.00	10.91	0.12	14.76	3.95	12.63	2.41	14.56			
12:23 PM	3.00	24.44	15.39	24.43	8.11	0.00	9.76	-0.02	10.92	0.13	14.84	4.03	12.70	2.48	14.56	1.61	220	
	3.20	24.51	15.46	24.48	8.11	-0.00	9.74	-0.03	10.93	0.14	14.92	4.11	12.77	2.55	14.56			
	3.40	24.56	15.51	24.54	8.11	0.00	9.73	-0.04	10.95	0.16	14.98	4.17	12.82	2.60	14.56			
	3.60	24.63	15.58	24.59	8.12	0.01	9.73	-0.04	10.96	0.17	15.04	4.23	12.87	2.65	14.56			
	3.80	24.68	15.63	24.66	8.12	0.01	9.73	-0.04	10.97	0.18	15.10	4.29	12.93	2.71	14.56			
12:24 PM	4.00	24.72	15.67	24.70	8.12	0.01	9.74	-0.03	10.98	0.19	15.16	4.35	12.99	2.77	14.56	1.60	220	
	4.20	24.77	15.72	24.74	8.12	0.01	9.74	-0.03	10.98	0.19	15.20	4.39	13.03	2.81	14.56			
	4.40	24.82	15.77	24.80	8.12	0.01	9.73	-0.04	10.99	0.20	15.25	4.44	13.07	2.85	14.56			
	4.60	24.85	15.80	24.84	8.12	0.01	9.72	-0.05	11.00	0.21	15.30	4.49	13.11	2.89	14.56			
	4.80	24.91	15.86	24.86	8.12	0.01	9.72	-0.05	11.02	0.23	15.34	4.53	13.15	2.93	14.56			
12:25 PM	5.00	24.94	15.89	24.90	8.13	0.02	9.72	-0.05	11.02	0.23	15.38	4.57	13.19	2.97	14.56	1.59	219	
	5.20	24.97	15.92	24.93	8.13	0.02	9.71	-0.06	11.02	0.23	15.42	4.61	13.23	3.01	14.56			
	5.40	25.01	15.96	24.97	8.13	0.02	9.71	-0.07	11.03	0.24	15.45	4.64	13.26	3.04	14.56			
	5.60	25.03	15.98	24.99	8.15	0.04	9.71	-0.06	11.05	0.26	15.49	4.68	13.29	3.07	14.56			
	5.80	25.09	16.04	25.06	8.15	0.04	9.72	-0.05	11.07	0.27	15.53	4.71	13.33	3.11	14.56			
12:26 PM	6.00	25.11	16.06	25.07	8.16	0.05	9.73	-0.04	11.08	0.29	15.55	4.74	13.36	3.14	14.56			
	6.20	25.13	16.08	25.11	8.16	0.05	9.73	-0.04	11.09	0.30	15.59	4.78	13.39	3.17	14.56			
	6.40	25.15	16.10	25.12	8.16	0.05	9.74	-0.03	11.09	0.30	15.61	4.80	13.42	3.20	14.56			
	6.60	25.19	16.14	25.16	8.16	0.05	9.74	-0.03	11.10	0.31	15.64	4.83	13.44	3.22	14.56			
	6.80	25.21	16.16	25.17	8.16	0.05	9.74	-0.03	11.12	0.33	15.67	4.86	13.47	3.25	14.56			
12:27 PM	7.00	25.22	16.17	25.19	8.17	0.06	9.75	-0.02	11.13	0.34	15.70	4.89	13.49	3.27	14.56			
	7.20	25.25	16.20	25.22	8.17	0.06	9.75	-0.02	11.14	0.35	15.72	4.91	13.52	3.30	14.56			
	7.40	25.28	16.23	25.26	8.17	0.06	9.76	-0.02	11.15	0.36	15.75	4.94	13.55	3.33	14.56			
	7.60	25.31	16.26	25.29	8.18	0.07	9.76	-0.01	11.16	0.37	15.77	4.96	13.57	3.35	14.56			
	7.80	25.31	16.26	25.30	8.18	0.07	9.76	-0.02	11.17	0.38	15.78	4.97	13.59	3.37	14.56			

Ground-Water Investigation in the Embarras River Valley for E J Water Corporation
Production Well 12 II 24-hr Aquifer Test: August 5-6,1997

Date/ Hour	Elapsed time (min)	Well 12 Depth to water (ft)	Well 12 Observed drwdwn (ft)	W12 Piez* Adj depth to water (ft)	Well 11 (OW) Depth to water (ft)	Well 11 (OW) Observed drwdwn (ft)	Observation Well 1 Depth to water (ft)	Observation Well 1 Observed drwdwn (ft)	Observation Well 2 Depth to water (ft)	Observation Well 2 Observed drwdwn (ft)	Observation Well 3 Depth to water (ft)	Observation Well 3 Observed drwdwn (ft)	Observation Well 4 Depth to water (ft)	Observation Well 4 Observed drwdwn (ft)	Approx barometric pressure (psia)	Piezometer head (ft)	Well 12 Pumping rate (gpm)	Remarks
12:28 PM	8.00	25.33	16.28	25.31	8.18	0.07	9.75	-0.02	11.17	0.38	15.80	4.99	13.60	3.38	14.56	1.59	219	
	8.20	25.36	16.31	25.34	8.18	0.07	9.75	-0.02	11.19	0.40	15.83	5.02	13.62	3.40	14.56			
	8.40	25.39	16.34	25.35	8.19	0.08	9.76	-0.02	11.19	0.40	15.85	5.04	13.64	3.42	14.56			
	8.60	25.37	16.32	25.35	8.20	0.09	9.76	-0.01	11.20	0.41	15.87	5.06	13.66	3.44	14.56			
	8.80	25.40	16.35	25.38	8.20	0.09	9.78	0.00	11.21	0.42	15.88	5.07	13.67	3.45	14.56			
12:29 PM	9.00	25.43	16.38	25.40	8.21	0.10	9.78	0.01	11.21	0.42	15.90	5.09	13.69	3.47	14.56	1.59	219	Water cloudy
	9.20	25.44	16.39	25.42	8.21	0.10	9.78	0.00	11.22	0.43	15.92	5.11	13.71	3.49	14.56			
	9.40	25.45	16.40	25.41	8.21	0.10	9.77	0.00	11.24	0.44	15.94	5.13	13.73	3.51	14.56			
	9.60	25.46	16.41	25.44	8.22	0.11	9.78	0.01	11.25	0.46	15.95	5.14	13.74	3.52	14.56			
	9.80	25.48	16.43	25.45	8.22	0.11	9.79	0.02	11.26	0.47	15.97	5.16	13.76	3.54	14.56			
12:30 PM	10	25.51	16.46	25.47	8.23	0.12	9.80	0.03	11.27	0.48	15.99	5.18	13.78	3.56	14.56	1.59	219	
12:32 PM	12	25.64	16.59	25.61	8.26	0.15	9.83	0.06	11.32	0.53	16.12	5.31	13.91	3.69	14.56	1.59	219	
12:34 PM	14	25.73	16.68	25.72	8.30	0.19	9.86	0.09	11.38	0.59	16.24	5.43	14.02	3.80	14.56	1.59	219	
12:36 PM	16	25.81	16.76	25.81	8.32	0.21	9.85	0.07	11.41	0.62	16.32	5.51	14.10	3.88	14.56	1.59	219	
12:38 PM	18	25.87	16.82	25.83	8.31	0.20	9.77	-0.01	11.41	0.62	16.39	5.58	14.11	3.89	14.57	1.59	219	
12:40 PM	20	25.91	16.86	25.88	8.35	0.24	9.86	0.09	11.44	0.65	16.45	5.64	14.20	3.98	14.56	1.58	218	Water clear
12:41 PM	21																	Adjust rate
12:42 PM	22	26.04	16.99	26.01	8.42	0.31	9.95	0.18	11.54	0.75	16.53	5.72	14.30	4.08	14.56	1.59	219	
12:44 PM	24	26.11	17.06	26.07	8.44	0.33	9.98	0.20	11.61	0.82	16.60	5.79	14.37	4.15	14.56	1.59	219	
12:46 PM	26	26.15	17.10	26.11	8.46	0.35	9.98	0.20	11.62	0.83	16.65	5.84	14.42	4.20	14.56	1.59	219	
12:48 PM	28	26.20	17.15	26.17	8.48	0.37	9.98	0.21	11.65	0.86	16.70	5.89	14.47	4.25	14.56	1.59	219	
12:50 PM	30	26.24	17.19	26.19	8.47	0.36	9.95	0.18	11.64	0.85	16.73	5.92	14.46	4.24	14.56	1.59	219	
12:52 PM	32	26.26	17.21	26.20	8.49	0.38	9.87	0.10	11.70	0.90	16.78	5.97	14.51	4.29	14.56			
12:54 PM	34	26.30	17.25	26.28	8.54	0.43	10.07	0.30	11.74	0.95	16.82	6.01	14.58	4.36	14.56			
12:56 PM	36	26.34	17.29	26.30	8.56	0.45	10.06	0.28	11.76	0.97	16.86	6.05	14.61	4.39	14.57	1.59	219	
12:58 PM	38	26.35	17.30	26.33	8.57	0.46	10.05	0.28	11.76	0.97	16.89	6.08	14.63	4.41	14.57			
01:00 PM	40	26.42	17.37	26.38	8.60	0.49	10.07	0.30	11.80	1.01	16.93	6.12	14.69	4.47	14.57			
01:02 PM	42	26.43	17.38	26.41	8.62	0.51	10.10	0.33	11.82	1.03	16.95	6.14	14.70	4.48	14.56	1.59	219	
01:04 PM	44	26.46	17.41	26.40	8.62	0.51	10.09	0.32	11.83	1.04	16.98	6.17	14.72	4.50	14.57			
01:06 PM	46	26.48	17.43	26.44	8.64	0.53	10.09	0.32	11.86	1.07	17.00	6.19	14.74	4.52	14.57			
01:08 PM	48	26.49	17.44	26.45	8.65	0.54	10.12	0.34	11.88	1.09	17.04	6.23	14.77	4.55	14.57			
01:10 PM	50	26.51	17.46	26.49	8.68	0.57	10.16	0.39	11.91	1.12	17.06	6.25	14.80	4.58	14.56	1.59	219	
01:12 PM	52	26.55	17.50	26.50	8.69	0.58	10.16	0.39	11.93	1.14	17.08	6.27	14.83	4.61	14.57			
01:14PM	54	26.55	17.50	26.52	8.70	0.59	10.15	0.38	11.92	1.13	17.10	6.29	14.84	4.62	14.57			
01:16PM	56	26.59	17.54	26.54	8.72	0.61	10.17	0.40	11.96	1.17	17.13	6.32	14.88	4.66	14.56			
01:18PM	58	26.60	17.55	26.56	8.71	0.60	10.14	0.37	11.92	1.13	17.14	6.33	14.86	4.64	14.57			
01:20 PM	60	26.62	17.57	26.57	8.72	0.61	10.09	0.32	11.98	1.19	17.17	6.36	14.89	4.67	14.57	1.59	219	
01:22 PM	62	26.63	17.58	26.57	8.76	0.65	10.14	0.37	12.02	1.23	17.18	6.37	14.91	4.69	14.57			
01:24 PM	64	26.66	17.61	26.64	8.79	0.68	10.29	0.52	12.04	1.25	17.20	6.39	14.96	4.74	14.57			
01:26 PM	66	26.67	17.62	26.64	8.78	0.67	10.21	0.44	12.03	1.24	17.22	6.41	14.97	4.75	14.56			
01:28 PM	68	26.67	17.62	26.63	8.79	0.68	10.23	0.46	12.05	1.26	17.24	6.43	14.98	4.76	14.56			
01:30 PM	70	26.69	17.64	26.63	8.79	0.68	10.21	0.44	12.05	1.26	17.25	6.44	14.98	4.76	14.56	1.58	218	
01:32 PM	72	26.72	17.67	26.69	8.83	0.72	10.30	0.53	12.09	1.30	17.27	6.46	15.02	4.80	14.56			Adjust rate
01:34 PM	74	26.79	17.74	26.78	8.84	0.73	10.30	0.53	12.09	1.30	17.30	6.49	15.05	4.83	14.56	1.59	219	
01:36 PM	76	26.79	17.74	26.78	8.84	0.73	10.29	0.52	12.10	1.31	17.32	6.51	15.05	4.83	14.56			
01:38 PM	78	26.81	17.76	26.77	8.81	0.70	10.18	0.41	12.07	1.28	17.32	6.51	15.03	4.81	14.56			

Ground-Water Investigation in the Embarras River Valley for E J Water Corporation
Production Well 12 II 24-hr Aquifer Test: August 5-6, 1997

Date / Hour	Elapsed time (min)	Well 12 Depth to water (ft)	Well 12 Observed drwdwn (ft)	W12 Piez* Adj depth to water (ft)	Well II (ow) Depth to water (ft)	Well II (ow) Observed drwdwn (ft)	Observation Well I Depth to water (ft)	Observation Well I Observed drwdwn (ft)	Observation Well 2 Depth to water (ft)	Observation Well 2 Observed drwdwn (ft)	Observation Well 3 Depth to water (ft)	Observation Well 3 Observed drwdwn (ft)	Observation Well 4 Depth to water (ft)	Observation Well 4 Observed drwdwn (ft)	Approx barometric pressure (psia)	Piiezometer head (ft)	Well 12 Pumping rate (gpm)	Remarks
01:40 PM	80	26.87	17.82	26.79	8.88	0.77	10.32	0.55	12.15	1.36	17.35	6.54	15.09	4.87	14.56	1.59	219	
01:42 PM	82	26.89	17.84	26.87	8.89	0.78	10.36	0.59	12.15	1.36	17.37	6.56	15.12	4.90	14.56			
01:44 PM	84	26.89	17.84	26.87	8.90	0.79	10.36	0.59	12.16	1.37	17.39	6.58	15.14	4.92	14.56			
01:46 PM	86	26.92	17.87	26.90	8.91	0.80	10.37	0.60	12.17	1.38	17.41	6.60	15.15	4.93	14.56			
01:48 PM	88	26.91	17.86	26.83	8.86	0.75	10.16	0.39	12.14	1.35	17.41	6.60	15.11	4.89	14.56			
01:50 PM	90	26.91	17.86	26.85	8.89	0.78	10.28	0.51	12.17	1.38	17.42	6.61	15.14	4.92	14.56	1.59	219	
01:52 PM	92	26.94	17.89	26.92	8.95	0.84	10.43	0.66	12.21	1.42	17.45	6.64	15.20	4.98	14.56			
01:54 PM	94	26.96	17.91	26.93	8.95	0.84	10.40	0.63	12.21	1.42	17.45	6.64	15.20	4.98	14.56			
01:56 PM	96	26.95	17.90	26.94	8.94	0.83	10.39	0.62	12.21	1.42	17.47	6.66	15.20	4.98	14.56			
01:58 PM	98	26.98	17.93	26.94	8.96	0.85	10.39	0.62	12.23	1.44	17.48	6.67	15.22	5.00	14.56			
02:00 PM	100	26.98	17.93	26.94	8.97	0.86	10.40	0.63	12.25	1.46	17.49	6.68	15.23	5.01	14.56	1.59	219	
02:20 PM	120	27.08	18.03	27.01	9.02	0.91	10.41	0.64	12.32	1.53	17.58	6.77	15.29	5.07	14.56	1.59	219	
02:40 PM	140	27.18	18.13	27.13	9.13	1.02	10.57	0.80	12.42	1.63	17.69	6.88	15.42	5.20	14.56	1.59	219	
02:50 PM	150																	Water sample collected;
03:00 PM	160	27.27	18.22	27.24	9.22	1.11	10.69	0.92	12.50	1.71	17.77	6.96	15.52	5.30	14.56	1.59	219	T = 55.2° F
03:20 PM	180	27.31	18.26	27.26	9.26	1.15	10.67	0.90	12.55	1.76	17.83	7.02	15.56	5.34	14.56	1.59	219	
03:40 PM	200	27.40	18.35	27.37	9.32	1.21	10.76	0.99	12.62	1.83	17.90	7.09	15.64	5.42	14.56	1.59	219	
04:00 PM	220	27.40	18.35	27.36	9.37	1.26	10.79	1.02	12.67	1.88	17.94	7.13	15.67	5.45	14.56	1.59	219	
04:20 PM	240	27.50	18.45	27.43	9.42	1.31	10.83	1.06	12.72	1.93	18.00	7.19	15.73	5.51	14.56	1.59	219	
04:40 PM	260	27.53	18.48	27.45	9.44	1.33	10.80	1.03	12.75	1.96	18.04	7.23	15.75	5.53	14.56	1.59	219	
05:00 PM	280	27.62	18.57	27.57	9.51	1.40	10.91	1.14	12.80	2.01	18.09	7.28	15.82	5.60	14.56	1.59	219	
05:20 PM	300	27.65	18.60	27.60	9.54	1.43	10.96	1.18	12.84	2.05	18.12	7.31	15.86	5.64	14.55	1.59	219	
05:40 PM	320	27.70	18.65	27.65	9.59	1.48	11.00	1.23	12.88	2.09	18.16	7.35	15.90	5.68	14.55	1.59	219	
06:00 PM	340	27.70	18.65	27.65	9.61	1.50	11.01	1.24	12.91	2.12	18.19	7.38	15.92	5.70	14.55	1.59	219	River stage = 0.56 ft
06:20 PM	360	27.75	18.70	27.67	9.63	1.52	11.04	1.27	12.94	2.15	18.22	7.41	15.95	5.73	14.55	1.59	219	
06:40 PM	380	27.75	18.70	27.69	9.67	1.56	11.08	1.31	12.98	2.19	18.25	7.44	15.97	5.75	14.55	1.59	219	
07:00 PM	400	27.83	18.78	27.77	9.70	1.59	11.10	1.33	13.00	2.21	18.28	7.47	16.00	5.78	14.55	1.59	219	
07:20 PM	420	27.88	18.83	27.79	9.73	1.62	11.14	1.37	13.03	2.24	18.31	7.50	16.04	5.82	14.54	1.59	219	
07:40 PM	440	27.88	18.83	27.83	9.76	1.65	11.16	1.39	13.06	2.27	18.33	7.52	16.06	5.84	14.54	1.58	218	Adjust rate
08:00 PM	460	27.89	18.84	27.82	9.79	1.68	11.19	1.42	13.08	2.29	18.35	7.54	16.08	5.86	14.54	1.59	219	
08:20 PM	480	27.99	18.94	27.91	9.82	1.71	11.22	1.45	13.11	2.32	18.40	7.59	16.12	5.90	14.54	1.59	219	
08:40 PM	500	28.00	18.95	27.92	9.84	1.73	11.25	1.47	13.14	2.35	18.42	7.61	16.14	5.92	14.54	1.59	219	
09:00 PM	520	28.05	19.00	27.98	9.87	1.76	11.28	1.51	13.17	2.38	18.45	7.64	16.17	5.95	14.54	1.59	219	
09:20 PM	540	28.07	19.02	28.01	9.90	1.79	11.30	1.53	13.20	2.41	18.47	7.66	16.20	5.98	14.54	1.59	219	
09:40 PM	560	28.11	19.06	28.03	9.92	1.81	11.32	1.55	13.21	2.42	18.49	7.68	16.22	6.00	14.54	1.59	219	
10:00 PM	580	28.11	19.06	28.04	9.94	1.83	11.35	1.58	13.23	2.44	18.51	7.70	16.24	6.02	14.54	1.59	219	
10:20 PM	600	28.11	19.06	28.04	9.96	1.85	11.37	1.60	13.25	2.46	18.53	7.72	16.25	6.03	14.54	1.59	219	
10:40 PM	620	28.17	19.12	28.13	9.98	1.87	11.39	1.62	13.27	2.48	18.55	7.74	16.27	6.05	14.53	1.57	217	Adjust rate
11:00 PM	640	28.24	19.19	28.15	10.00	1.89	11.40	1.63	13.29	2.50	18.57	7.76	16.30	6.08	14.53	1.59	219	
11:20 PM	660	28.27	19.22	28.19	10.02	1.91	11.42	1.65	13.31	2.52	18.59	7.78	16.31	6.09	14.53	1.59	219	
11:40 PM	680	28.31	19.26	28.22	10.04	1.93	11.45	1.67	13.33	2.54	18.62	7.81	16.34	6.12	14.53	1.59	219	
08/06/97																		
12:00 AM	700	28.31	19.26	28.23	10.06	1.95	11.46	1.69	13.35	2.56	18.64	7.83	16.36	6.14	14.54	1.59	219	
12:20 AM	720	28.37	19.32	28.30	10.08	1.97	11.49	1.72	13.37	2.58	18.66	7.85	16.38	6.16	14.54	1.59	219	
12:40 AM	740	28.41	19.36	28.33	10.10	1.99	11.50	1.73	13.38	2.59	18.68	7.87	16.39	6.17	14.54	1.59	219	
01:00 AM	760	28.43	19.38	28.35	10.11	2.00	11.52	1.75	13.40	2.61	18.69	7.88	16.41	6.19	14.54	1.59	219	

Ground-Water Investigation in the Embarras River Valley for E J Water Corporat on

Production Well 12 II 24-hr Aquifer Test: August 5-6,1997

Date/ Hour	Elapsed time (min)	Well 12 Depth to water (ft)	Well 12 Observed drwdwn (ft)	W12 Piez* Adj depth to water (ft)	Well II (OW) Depth to water (ft)	Well II (OW) Observed drwdwn (ft)	Observation Well 1 Depth to water (ft)	Observation Well 1 Observed drwdwn (ft)	Observation Well 2 Depth to water (ft)	Observation Well 2 Observed drwdwn (ft)	Observation Well 3 Depth to water (ft)	Observation Well 3 Observed drwdwn (ft)	Observat on Well 4 Depth to water (ft)	Observat on Well 4 Observed drwdwn (ft)	Approx barometric pressure (psia)	Piezometer head (ft)	Well 12 Pumping rate (gpm)	Remarks
01:20 AM	780	28.48	19.43	28.40	10.13	2.02	11.53	1.76	13.42	2.63	18.72	7.91	16.43	6.21	14.54	1.59	219	
01:40 AM	800	28.51	19.46	28.43	10.14	2.03	11.54	1.77	13.43	2.64	18.73	7.92	16.44	6.22	14.53	1.59	219	
02:00 AM	820	28.53	19.48	28.44	10.15	2.04	11.55	1.78	13.44	2.65	18.74	7.93	16.45	6.23	14.53	1.59	219	
02:20 AM	840	28.53	19.48	28.45	10.17	2.06	11.57	1.80	13.45	2.66	18.76	7.95	16.47	6.25	14.53	1.59	219	
02:40 AM	860	28.56	19.51	28.46	10.18	2.07	11.58	1.81	13.47	2.68	18.76	7.95	16.47	6.25	14.53	1.59	219	
03:00 AM	880	28.57	19.52	28.48	10.19	2.08	11.60	1.83	13.48	2.69	18.78	7.97	16.49	6.27	14.53	1.59	219	
03:20 AM	900	28.61	19.56	28.52	10.21	2.10	11.61	1.84	13.49	2.70	18.79	7.98	16.50	6.28	14.53			
03:40 AM	920	28.62	19.57	28.55	10.22	2.11	11.62	1.85	13.50	2.71	18.80	7.99	16.51	6.29	14.53			
04:00 AM	940	28.62	19.57	28.56	10.23	2.12	11.63	1.86	13.51	2.72	18.81	8.00	16.52	6.30	14.53	1.59	219	
04:20 AM	960	28.64	19.59	28.56	10.24	2.13	11.64	1.87	13.52	2.73	18.81	8.00	16.53	6.31	14.53			
04:40 AM	980	28.67	19.62	28.58	10.25	2.14	11.65	1.88	13.54	2.75	18.83	8.02	16.54	6.32	14.53			
05:00 AM	1000	28.69	19.64	28.61	10.27	2.16	11.67	1.90	13.55	2.76	18.84	8.03	16.55	6.33	14.53	1.59	219	
05:20 AM	1020	28.73	19.68	28.65	10.28	2.17	11.68	1.91	13.56	*2.11*	18.86	8.05	16.56	6.34	14.53			
05:40 AM	1040	28.76	19.71	28.68	10.29	2.18	11.70	1.93	13.57	2.78	18.87	8.06	16.58	6.36	14.53			
06:00 AM	1060	28.76	19.71	28.70	10.30	2.19	11.71	1.94	13.59	2.80	18.89	8.08	16.59	6.37	14.53	1.59	219	
06:20 AM	1080	28.81	19.76	28.72	10.32	2.21	11.72	1.95	13.60	2.81	18.90	8.09	16.60	6.38	14.53			
06:40 AM	1100	28.82	19.77	28.73	10.33	2.22	11.74	1.97	13.61	2.82	18.91	8.10	16.61	6.39	14.53			
07:00 AM	1120	28.85	19.80	28.77	10.34	2.23	11.75	1.98	13.62	2.83	18.92	8.11	16.63	6.41	14.54	1.59	219	River stage = 0.54 ft
07:20 AM	1140	28.86	19.81	28.77	10.36	2.25	11.77	2.00	13.64	2.85	18.93	8.12	16.64	6.42	14.54			
07:40 AM	1160	28.87	19.82	28.78	10.37	2.26	11.78	2.01	13.66	2.87	18.95	8.14	16.66	6.44	14.55			
08:00 AM	1180	28.91	19.86	28.81	10.38	2.27	11.79	2.02	13.66	2.87	18.96	8.15	16.67	6.45	14.55	1.58	218	Adjust rate
08:20 AM	1200	28.91	19.86	28.84	10.39	2.28	11.80	2.03	13.67	2.88	18.97	8.16	16.68	6.46	14.56			
08:40 AM	1220	28.90	19.85	28.82	10.39	2.28	11.80	2.03	13.68	2.89	18.97	8.16	16.68	6.46	14.56			
09:00 AM	1240	28.90	19.85	28.83	10.40	2.29	11.81	2.04	13.69	2.90	18.98	8.17	16.69	6.47	14.57	1.59	219	
09:20 AM	1260	28.91	19.86	28.83	10.41	2.30	11.82	2.05	13.69	2.90	18.98	8.17	16.69	6.47	14.57			
09:40 AM	1280	28.91	19.86	28.84	10.42	2.31	11.83	2.06	13.70	2.91	19.00	8.19	16.71	6.49	14.58			
10:00 AM	1300	28.93	19.88	28.86	10.43	2.32	11.82	2.05	13.71	2.92	19.00	8.19	16.70	6.48	14.58	1.59	219	
10:20 AM	1320	28.96	19.91	28.89	10.45	2.34	11.86	2.09	13.72	2.93	19.02	8.21	16.74	6.52	14.59			
10:40 AM	1340	28.93	19.88	28.84	10.45	2.34	11.87	2.09	13.74	2.95	19.02	8.21	16.73	6.51	14.59			
11:00 AM	1360	28.94	19.89	28.87	10.45	2.34	11.85	2.08	13.74	2.95	19.02	8.21	16.74	6.52	14.59	1.59	219	
11:05 AM	1365	28.99	19.94															Dropline measurement
11:06 AM	1366			28.95														Dropline measurement
11:07 AM	1367										19.09	8.28						Dropline measurement
11:08 AM	1368												16.79	6.57				Dropline measurement
11:10AM	1370								13.78	2.99								Dropline measurement
11:12AM	1372				10.48													Dropline measurement
11:13 AM	1373						11.82	2.05										Dropline measurement
11:20 AM	1380	28.95	19.90	28.88	10.45	2.34	11.86	2.09	13.74	2.95	19.03	8.22	16.74	6.52	14.60	1.59	219	Water sample collected; T = 55.2° F
11:40 AM	1400	28.94	19.89	28.83	10.46	2.35	11.88	2.10	13.74	2.95	19.03	8.22	16.74	6.52	14.59	1.59	219	Pump OFF
	0.008	28.09		28.02	10.46		11.88		13.76		19.03		16.74		14.59			Water level recovery
	0.017	28.24		28.17	10.46		11.88		13.76		19.02		16.74		14.59			
	0.025	27.72		27.57	10.46		11.88		13.76		19.02		16.74		14.59			
	0.033	27.09		26.92	10.46		11.88		13.76		19.01		16.74		14.59			
	0.042	26.47		26.33	10.46		11.88		13.76		19.01		16.74		14.59			
	0.050	25.89		25.75	10.46		11.88		13.76		18.99		16.73		14.59			

Ground-Water Investigation in the Embarras River Valley for E J Water Corporation
Production Well 12 II 24-hir Aquifer Test: August 5-6, 1997

Date / Hour	Elapsed time (min)	Well 12 Depth to water (ft)	Well 12 Observed drwdwn (ID	W12 Piez* Adj depth to water (ft)	Well II (OW) Depth to water (ft)	Well II (OW) Observed drwdwn (ft)	Observation Well 1 Depth to water (ft)	Observation Well 1 Observed drwdwn (ft)	Observation Well 2 Depth to water (ft)	Observation Well 2 Observed drwdwn (ft)	Observation Well 3 Depth to water (ft)	Observation Well 3 Observed drwdwn (ft)	Observation Well 4 Depth to water (ft)	Observation Well 4 Observed drwdwn (ft)	Approx barometric pressure (psia)	Piezometer head (ft)	Well 12 Pumping rate (gpm)	Remarks
	0.058	25.32		25.17	10.46		11.88		13.76		18.97		16.73		14.59			
	0.067	24.79		24.65	10.46		11.88		13.76		18.95		16.73		14.59			
	0.075	24.29		24.15	10.46		11.88		13.76		18.92		16.73		14.59			
	0.083	23.80		23.67	10.46		11.88		13.76		18.90		16.73		14.59			
	0.092	22.04		21.58	10.46		11.88		13.76		18.86		16.72		14.59			
	0.100	21.90		21.84	10.46		11.88		13.76		18.82		16.72		14.59			
	0.108	21.44		21.19	10.46		11.88		13.76		18.78		16.71		14.59			
	0.117	20.52		20.38	10.46		11.88		13.76		18.73		16.71		14.59			
	0.125	19.84		19.70	10.46		11.88		13.76		18.68		16.70		14.59			
	0.133	19.25		19.12	10.46		11.88		13.76		18.63		16.69		14.59			
	0.142	18.74		18.62	10.46		11.88		13.76		18.57		16.68		14.59			
	0.150	18.28		18.18	10.46		11.88		13.76		18.51		16.67		14.59			
	0.158	17.93		17.82	10.46		11.88		13.76		18.45		16.66		14.59			
	0.167	17.62		17.52	10.46		11.88		13.76		18.38		16.65		14.59			
	0.175	17.37		17.27	10.46		11.88		13.76		18.32		16.64		14.59			
	0.183	17.17		17.07	10.46		11.88		13.76		18.26		16.63		14.59			
	0.192	17.02		16.93	10.46		11.88		13.75		18.20		16.61		14.59			
	0.200	16.91		16.82	10.46		11.88		13.76		18.14		16.60		14.59			
	0.208	16.85		16.77	10.46		11.88		13.76		18.08		16.59		14.59			
	0.217	16.82		16.75	10.46		11.88		13.76		18.03		16.57		14.59			
	0.225	16.81		16.74	10.46		11.88		13.76		17.98		16.56		14.59			
	0.233	16.82		16.75	10.46		11.88		13.76		17.93		16.54		14.60			
	0.242	16.83		16.76	10.46		11.88		13.76		17.88		16.53		14.59			
	0.250	16.84		16.77	10.46		11.88		13.76		17.84		16.51		14.59			
	0.258	16.85		16.78	10.46		11.88		13.76		17.80		16.49		14.59			
	0.267	16.85		16.78	10.46		11.88		13.76		17.76		16.48		14.59			
	0.275	16.85		16.77	10.46		11.88		13.76		17.72		16.46		14.59			
	0.283	16.85		16.77	10.46		11.88		13.76		17.68		16.45		14.59			
	0.292	16.84		16.76	10.46		11.88		13.76		17.65		16.43		14.59			
	0.300	16.82		16.75	10.46		11.88		13.76		17.61		16.42		14.59			
	0.308	16.81		16.74	10.46		11.88		13.76		17.59		16.40		14.59			
	0.317	16.80		16.72	10.46		11.88		13.75		17.55		16.38		14.59			
	0.325	16.79		16.71	10.46		11.88		13.76		17.53		16.37		14.59			
	0.333	16.77		16.70	10.46		11.88		13.76		17.51		16.35		14.59			
	0.350	16.76		16.67	10.46		11.88		13.76		17.46		16.32		14.60			
	0.367	16.72		16.64	10.46		11.88		13.75		17.41		16.29		14.59			
	0.383	16.68		16.60	10.46		11.88		13.76		17.36		16.27		14.60			
	0.400	16.64		16.56	10.46		11.87		13.75		17.32		16.23		14.59			
	0.417	16.61		16.52	10.46		11.88		13.76		17.28		16.21		14.60			
	0.433	16.57		16.50	10.45		11.87		13.75		17.24		16.18		14.60			
	0.450	16.53		16.45	10.45		11.87		13.76		17.20		16.15		14.59			
	0.467	16.49		16.41	10.45		11.87		13.75		17.17		16.13		14.59			
	0.483	16.45		16.36	10.45		11.87		13.75		17.14		16.10		14.59			
	0.500	16.41		16.33	10.45		11.87		13.75		17.10		16.08		14.59			
	0.517	16.37		16.29	10.45		11.87		13.75		17.06		16.05		14.59			
	0.533	16.33		16.25	10.45		11.87		13.75.		17.04		16.03		14.59			

Ground-Water Investigation in the Embarras River Valley for E J Water Corporation
Production Well 12 II 24-hr Aquifer Test: August 5-6, 1997

Date/ Hour	Elapsed time (min)	Well 12 Depth to water (ft)	Well 12 Observed drwdwn (ft)	W12 Piez* Adj depth to water (ft)	Well 11 (OW) Depth to water (ft)	Well 11 (OW) Observed drwdwn (ft)	Observation Well 1 Depth to water (ft)	Observation Well 1 Observed drwdwn (ft)	Observation Well 2 Depth to water (ft)	Observation Well 2 Observed drwdwn (ft)	Observation Well 3 Depth to water (ft)	Observation Well 3 Observed drwdwn (ft)	Observation Well 4 Depth to water (ft)	Observation Well 4 Observed drwdwn (ft)	Approx barometric pressure (psia)	Piezometer head (ft)	Well 12 Pumping rate (gpm)	Remarks
	0.550	16.30		16.20	10.45		11.87		13.75		17.01		16.00		14.60			
	0.567	16.26		16.17	10.45		11.87		13.75		16.97		15.98		14.59			
	0.583	16.21		16.13	10.45		11.87		13.75		16.94		15.96		14.59			
	0.600	16.17		16.09	10.45		11.87		13.75		16.92		15.93		14.59			
	0.617	16.14		16.05	10.45		11.86		13.76		16.89		15.91		14.59			
	0.633	16.10		16.02	10.45		11.86		13.75		16.86		15.89		14.59			
	0.650	16.06		15.98	10.45		11.86		13.75		16.83		15.87		14.60			
	0.667	16.02		15.94	10.45		11.86		13.75		16.81		15.84		14.59			
	0.683	15.99		15.90	10.45		11.86		13.75		16.79		15.82		14.59			
	0.700	15.96		15.87	10.45		11.86		13.75		16.76		15.80		14.59			
	0.717	15.92		15.84	10.45		11.86		13.75		16.73		15.78		14.59			
	0.733	15.88		15.80	10.45		11.86		13.75		16.71		15.76		14.59			
	0.750	15.85		15.76	10.45		11.86		13.75		16.69		15.74		14.59			
	0.767	15.82		15.74	10.45		11.86		13.75		16.67		15.72		14.59			
	0.783	15.79		15.70	10.45		11.86		13.75		16.65		15.70		14.59			
	0.800	15.75		15.67	10.45		11.86		13.75		16.62		15.68		14.59			
	0.817	15.72		15.63	10.45		11.86		13.75		16.60		15.66		14.59			
	0.833	15.69		15.60	10.45		11.86		13.75		16.58		15.65		14.59			
	0.850	15.66		15.58	10.45		11.86		13.75		16.56		15.63		14.59			
	0.867	15.63		15.54	10.45		11.86		13.75		16.54		15.61		14.59			
	0.883	15.60		15.51	10.45		11.86		13.74		16.52		15.59		14.60			
	0.900	15.56		15.48	10.45		11.86		13.74		16.50		15.57		14.59			
	0.917	15.54		15.45	10.45		11.86		13.74		16.48		15.56		14.59			
	0.933	15.51		15.43	10.46		11.86		13.74		16.47		15.54		14.59			
	0.950	15.48		15.40	10.46		11.86		13.74		16.44		15.52		14.59			
	0.967	15.45		15.37	10.46		11.86		13.74		16.43		15.51		14.59			
	0.983	15.42		15.34	10.45		11.86		13.74		16.41		15.49		14.60			
11:41 AM	1.00	15.39		15.31	10.45		11.86		13.74		16.39		15.48		14.59			
	1.20	15.10		15.02	10.46		11.85		13.74		16.20		15.30		14.60			
	1.40	14.86		14.77	10.46		11.85		13.73		16.03		15.15		14.59			
	1.60	14.64		14.56	10.46		11.86		13.72		15.89		15.02		14.59			
	1.80	14.47		14.38	10.46		11.86		13.71		15.77		14.90		14.59			
11:42 AM	2.00	14.31		14.22	10.45		11.86		13.70		15.65		14.80		14.59			
	2.20	14.16		14.08	10.46		11.87		13.69		15.56		14.71		14.59			
	2.40	14.03		13.96	10.46		11.88		13.68		15.47		14.63		14.59			
	2.60	13.92		13.85	10.47		11.88		13.66		15.39		14.55		14.59			
	2.80	13.82		13.74	10.47		11.88		13.65		15.31		14.48		14.59			
11:43 AM	3.00	13.71		13.64	10.46		11.88		13.64		15.21		14.42		14.59			
	3.20	13.61		13.55	10.46		11.88		13.63		15.13		14.36		14.59			
	3.40	13.52		13.44	10.45		11.88		13.62		15.06		14.29		14.59			
	3.60	13.42		13.36	10.45		11.88		13.61		14.98		14.23		14.59			
	3.80	13.21		13.27	10.45		11.87		13.59		14.91		14.17		14.59			
11:44 AM	4.00	13.09		13.19	10.44		11.86		13.58		14.84		14.11		14.59			
	4.20	13.02		13.12	10.44		11.86		13.57		14.79		14.06		14.59			
	4.40	12.95		13.05	10.44		11.86		13.56		14.74		14.02		14.59			
	4.60	12.89		12.99	10.43		11.85		13.55		14.69		13.97		14.59			

Ground-Water Investigation in the Embarras River Valley for E J Water Corporation
Production Well 12 II 24-hr Aquifer Test: ,August 5-6, 1997

Date/ Hour	Elapsed time (min)	Well 12 Depth to water (ft)	Well 12 Observed drwdwn (ft)	W12 Piez* Adj depth to water (ft)	Well 11 (OW) Depth to water (ft)	Well 11 (OW) Observed drwdwn (ft)	Observation Well I Depth to water (ft)	Observation Well I Observed drwdwn (ft)	Observation Well 2 Depth to water (ft)	Observation Well 2 iObserved drwdwn (ft)	Observation Well 3 Depth to water (ft)	Observation Well 3 Observed drwdwn (ft)	Observation Well 4 Depth to water (ft)	Observation Well 4 Observed drwdwn (ft)	Approx barometric pressure (psia)	Piezometer head (ft)	Well 12 Pumping rate (gpm)	Remarks
	4.80	12.83		12.94	10.43		11.85		13.54		14.64		13.93		14.59			
11:45 AM	5.00	12.78		12.88	10.43		11.85		13.52		14.59		13.88		14.59			
	5.20	12.72		12.82	10.42		11.84		13.51		14.55		13.84		14.59			
	5.40	12.67		12.77	10.41		11.83		13.49		14.51		13.80		14.59			
	5.60	12.63		12.72	10.41		11.81		13.49		14.46		13.76		14.59			
	5.80	12.58		12.67	10.40		11.80		13.47		14.43		13.73		14.59			
11:46 AM	6.00	12.54		12.64	10.39		11.79		13.46		14.40		13.70		14.59			
	6.20	12.50		12.60	10.39		11.79		13.46		14.36		13.67		14.59			
	6.40	12.47		12.55	10.40		11.80		13.45		14.34		13.65		14.60			
	6.60	12.43		12.52	10.40		11.81		13.44		14.30		13.62		14.59			
	6.80	12.39		12.49	10.40		11.81		13.43		14.28		13.60		14.60			
11:47 AM	7.00	12.36		12.45	10.40		11.82		13.42		14.24		13.58		14.60			
	7.20	12.33		12.42	10.40		11.82		13.42		14.22		13.55		14.60			
	7.40	12.30		12.39	10.40		11.83		13.41		14.19		13.53		14.59			
	7.60	12.27		12.36	10.39		11.83		13.40		14.18		13.51		14.60			
	7.80	12.24		12.34	10.39		11.82		13.40		14.15		13.49		14.59			
11:48 AM	8.00	12.22		12.31	10.37		11.81		13.38		14.13		13.48		14.60			
	8.20	12.19		12.29	10.36		11.79		13.37		14.10		13.46		14.60			
	8.40	12.17		12.26	10.35		11.76		13.34		14.08		13.43		14.60			
	8.60	12.15		12.24	10.34		11.73		13.32		14.05		13.40		14.60			
	8.80	12.11		12.20	10.33		11.71		13.32		14.03		13.35		14.60			
11:49 AM	9.00	12.09		12.18	10.33		11.70		13.32		14.01		13.32		14.60			
	9.20	12.07		12.16	10.32		11.69		13.32		14.00		13.32		14.60			
	9.40	12.06		12.15	10.33		11.70		13.32		13.99		13.32		14.60			
	9.60	12.04		12.13	10.33		11.71		13.32		13.97		13.32		14.59			
	9.80	12.03		12.12	10.34		11.72		13.32		13.96		13.32		14.60			
11:50 AM	10	12.02		12.11	10.33		11.73		13.32		13.94		13.31		14.60			
11:52 AM	12	11.87		11.97	10.34		11.84		13.24		13.79		13.18		14.59			
11:54 AM	14	11.74		11.85	10.30		11.81		13.19		13.68		13.06		14.60			
11:56 AM	16	11.65		11.74	10.26		11.74		13.14		13.58		12.97		14.60			
11:58 AM	18	11.56		11.65	10.23		11.71		13.07		13.50		12.88		14.60			
12:00 PM	20	11.50		11.59	10.21		11.73		13.06		13.44		12.83		14.60			
12:02 PM	22	11.43		11.53	10.18		11.69		13.00		13.37		12.77		14.60			
12:04 PM	24	11.39		11.48	10.16		11.67		12.98		13.32		12.72		14.60			
12:06 PM	26	11.32		11.42	10.14		11.66		12.94		13.26		12.66		14.60			
12:08 PM	28	11.29		11.40	10.12		11.66		12.92		13.23		12.64		14.60			
12:10 PM	30	11.25		11.35	10.10		11.63		12.89		13.18		12.60		14.60			
12:12 PM	32	11.21		11.29	10.08		11.61		12.86		13.14		12.55		14.60			
12:14 PM	34	11.14		11.21	10.07		11.53		12.81		13.09		12.45		14.60			
12:16 PM	36	11.11		11.18	10.01		11.52		12.79		13.06		12.45		14.60			
12:18 PM	38	11.10		11.18	10.03		11.58		12.80		13.04		12.45		14.60			
12:20 PM	40	11.08		11.17	10.01		11.58		12.77		13.01		12.45		14.60			
12:22 PM	42	11.04		11.14	10.00		11.55		12.76		12.98		12.41		14.60			
12:24 PM	44	11.01		11.11	9.98		11.56		12.75		12.95		12.39		14.60			
12:26 PM	46	10.98		11.10	9.97		11.53		12.72		12.93		12.35		14.60			
12:28 PM	48	10.95		11.06	9.95		11.52		12.70		12.90		12.32		14.60			

Ground-Water Investigation in the Embarras River Valley for E J Water Corporation
Production Well 12 II 24-hr Aquifer Test: August;5-6, 1997

Date / Hour	Elapsed lime (min)	Well 12 Depth to water (ft)	Well 12 Observed drwdwn (ft)	W12 Piez* Adj depth to water (ft)	Well // (OW) Depth to water (ft)	Well // (OW) Observed drwdwn (ft)	Observation Well 1 Depth to water (ft)	Observation Well 1 Observed drwdwn (ft)	Observation Well 2 Depth • to water (ft)	Observation Well 2 Observed drwdwn (ft)	Observation Well 3 Depth to water (ft)	Observation Well 3 Observed drwdwn (ft)	Observation Well 4 Depth to water (ft)	Observation Well 4 (Observed drwdwn (ft)	Approx barometric pressure (psia)	Piezometer head (ft)	Well 12 Pumping rate (gpm)	Remarks
12:30 PM	50	10.92		11.02	9.94		11.51		12.67		12.87		12.27		14.60			
12:32 PM	52	10.88		10.95	9.91		11.44		12.65		12.83		12.20		14.60			
12:34 PM	54	10.88		10.97	9.90		11.46		12.61		12.82		12.25		14.60			
12:36 PM	56	10.86		10.93	9.86		11.33		12.60		12.80		12.20		14.60			
12:38 PM	58	10.84		10.94	9.89		11.49		12.60		12.78		12.22		14.60			
12:40 PM	60	10.82		10.92	9.86		11.39		12.58		12.76		12.19		14.60			
12:42 PM	62	10.80		10.91	9.85		11.42		12.57		12.74		12.18		14.60			
12:44 PM	64	10.79		10.88	9.84		11.39		12.55		12.73		12.15		14.60			
12:46 PM	66	10.77		10.86	9.84		11.43		12.57		12.71		12.14		14.60			
12:48 PM	68	10.75		10.84	9.82		11.38		12.53		12.69		12.12		14.60			
12:50 PM	70	10.71		10.79	9.78		11.30		12.50		12.67		12.05		14.60			
12:52 PM	72	10.70		10.76	9.75		11.21		12.47		12.64		12.04		14.60			
12:54 PM	74	10.69		10.76	9.76		11.28		12.48		12.63		12.05		14.60			
12:56 PM	76	10.68		10.76	9.76		11.30		12.47		12.62		12.04		14.60			
12:58 PM	78	10.68		10.79	9.79		11.40		12.48		12.61		12.07		14.60			
01:00 PM	80	10.66		10.78	9.73		11.30		12.44		12.60		12.05		14.60			
01:02 PM	82	10.64		10.72	9.76		11.36		12.46		12.58		12.00		14.60			
01:04 PM	84	10.64		10.74	9.74		11.38		12.45		12.57		12.00		14.60			
01:06 PM	86	10.62		10.73	9.72		11.32		12.41		12.55		11.99		14.60			
01:08 PM	88	10.60		10.69	9.70		11.28		12.41		12.54		11.97		14.59			
01:10PM	90	10.59		10.69	9.70		11.29		12.40		12.53		11.96		14.59			River stage = 0.54
01:12 PM	92	10.57		10.67	9.69		11.27		12.38		12.51		11.94		14.59			
01:14 PM	94	10.55		10.65	9.68		11.26		12.37		12.50		11.92		14.59			
01:16PM	96	10.54		10.64	9.67		11.24		12.37		12.49		11.91		14.59			
01:18 PM	98	10.53		10.64	9.66		11.25		12.36		12.48		11.91		14.59			
01:20 PM	100	10.52		10.62	9.65		11.23		12.34		12.46		11.89		14.59			
01:40 PM	120	10.42		10.52	9.58		11.17		12.26		12.36		11.79		14.59			
02:00 PM	140	10.33		10.41							12.24		11.69		14.59			End of aquifer test

Notes: *Piezometer is installed in approximate middle of gravel pack outside well screen. Adjusted depth to water are from same total organic compounds reference point as Well 12.

Adj = adjusted

Approx = approximate

drwdwn = drawdown

ft = feet

gpm = gallons per minute

OW = observation well

psia = pounds per square inch absolute

Appendix K.

Chemical Analyses of Water Samples: Production Well 12

ILLINOIS DEPARTMENT OF NATURAL RESOURCES

Illinois State Water Survey

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SWS

September 16, 1997

Mr. David Klitzing
General Manager
EJ Water Corporation
P.O. Box 8
Dieterich, IL 61424

Dear Mr. Klitzing:

We are enclosing a copy of each of the partial analyses made on samples of untreated water collected August 5 and 6, 1997, from the 48 foot Well No. 12 owned by EJ Water Corporation in Jasper County.

The analyses show these samples to be moderately mineralized and moderately hard. The iron and manganese contents of this water are at a level which can result in the staining of porcelain and laundry. A major portion of the turbidity in these samples appears to be due to the previously soluble iron which oxidized and became insoluble after the water was exposed to air.

The hardness in these samples is sufficient to cause the formation of a moderate amount of soft scale in boilers and hot water heaters and to consume a moderate amount of soap if used for washing or laundry purposes.

If we can be of further assistance, please let us hear from you.

Very truly yours,

Brian W. Kaiser
Associate Chemist
217/333-9234

llj

Enclosures as stated

cc: Pat Milano, Milano and Grunloh Engineers, Inc.
James A. Speth, Speth Plumbing
Ellis W. Sanderson, ISWS
IEPA (2)

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SWS

WATER SAMPLE DATA
LABORATORY SAMPLE NUMBER: 230316

SOURCE: WELL NO. 12
OWNER: E.J. WATER CORP.
LOCATION: JASPER CO.
COUNTY: JASPER TOWNSHIP: 07N RANGE: 09E SECTION: 10.4F
DATE COLLECTED: 08/05/1997 DATE RECEIVED: 08/07/1997
WELL DEPTH (Ft.): 48.0 TEMPERATURE REPORTED (F): 55.2
TREATMENT: NONE
COMMENTS: SAMPLE COLLECTED AFTER PUMPING 150 MINUTES AT RATE OF ABOUT 219 GP M.

PARAMETER:	mg/L	PARAMETER:	mg/L
Iron (Total Fe):	1.57	Fluoride (F):	0.2
Manganese (Mn):	0.52	Chloride (Cl):	11.0
Calcium (Ca):	60.4	Sulfate (S04):	48.1
Magnesium (Mg):	16.9	Nitrate (N03-N):	1.0
Sodium (Na):	14.0		
Aluminum (Al):	0.15		
Barium (Ba):	0.06		
Beryllium (Be):	< 0.003		
Boron (B):	< 0.13		
Chromium (Cr):	< 0.007		
Copper (Cu):	0.02		
Nickel (Ni):	< 0.031		
Zinc (Zn):	< 0.02		
Turbidity(Lab, NTU):	13	Alkalinity (CaC03):	212
Color (PCU):	5	Hardness (as CaC03):	219
pH (Lab):	7.4	Total Dissolved Minerals:	312
Odor:	NONE		

< = Below detection limit (i.e. <1.0 = less than 1.0 mg/L)
mg/L = milligrams per liter mg/L x 0.0584 = grains per gallon
uS/cm = microsiemens per centimeter
ND = Not determined/Information not available

IEPA Certified Environmental Laboratory, Number 100202

Analysts: Lauren F. Sievers
Associate Chemist

Daniel L. Webb
Associate Chemist

ILLINOIS DEPARTMENT OF NATURAL RESOURCES

Illinois State Water Survey

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SWS

WATER SAMPLE DATA
LABORATORY SAMPLE NUMBER: 230317

SOURCE: WELL NO. 12
OWNER: E.J. WATER CORP.
LOCATION: JASPER CO.
COUNTY: JASPER TOWNSHIP: 07N RANGE: 09E SECTION: 10.4F
DATE COLLECTED: 08/06/1997 DATE RECEIVED: 08/07/1997
WELL DEPTH (Ft.): 48.0 TEMPERATURE REPORTED (F): 55.2
TREATMENT: NONE
COMMENTS: SAMPLE COLLECTED AFTER PUMPING 1380 MINUTES AT RATE OF ABOUT 219 G PM.

PARAMETER:	mg/L	PARAMETER:	mg/L
Iron (Total Fe):	1.36	Fluoride (F):	0.1
Manganese (Mn):	0.49	Chloride (Cl):	11.3
Calcium (Ca):	63.8	Sulfate (S04):	47.7
Magnesium (Mg):	20.5	Nitrate (N03-N):	1.1
Sodium (Na):	15.0		
Aluminum (Al):	0.11		
Barium (Ba):	0.05		
Beryllium (Be):	< 0.003		
Boron (B):	< 0.13		
Chromium (Cr):	< 0.007		
Copper (Cu):	< 0.01		
Nickel (Ni):	< 0.031		
Zinc (Zn):	< 0.02		
Turbidity(Lab, NTU):	9.5	Alkalinity (CaC03):	213
Color (PCU):	5	Hardness (as CaC03):	243
pH (Lab):	7.4	Total Dissolved Minerals:	316
Odor:	NONE		

< = Below detection limit (i.e. <1.0 = less than 1.0 mg/L)
mg/L - milligrams per liter mg/L x 0.0584 = grains per gallon
uS/cm = microsiemens per centimeter
ND = Not determined/Information not available

IEPA Certified Environmental Laboratory, Number 100202

Analysts: Lauren F. Sievers
Associate Chemist

Daniel L. Webb
Associate Chemist

Appendix L.

Correspondence

Illinois State Water Survey

Hydrology Division
2204 Griffith Drive
Champaign, Illinois 61820-7495
Telephone (217) 333-4300
Telefax (217) 333-6540

December 13, 1994

Mr. Delbert Mundt, President
E J Water Corporation
P.O. Box 8
Dieterich, IL 61424

Dear Mr. Mundt:

This letter is in response to our telephone conversation on December 8, 1994, regarding possible future steps for exploratory test drilling following the Electrical Earth Resistivity Survey (EERS) conducted on October 25-26, 1994, by Mr. Phil Reed of the State Geological Survey. The EERS was conducted in Sections 3, 10, 11, 14, and 15, T.7 N., R.9 E., Jasper County, about 2 miles south the existing well field operated by the E J Water Corporation. We understand the EERS was conducted to help locate a possible site for a second well field to allow for expansion of the distribution system.

We suggest the following strategy to evaluate the potential yield of a well field at the suggested site:

Step 1: Drill at least two or three test borings at sites suggested in the EERS Report dated December 2, 1994. These test borings should be at or near EERS stations 134 and/or 135 and at station 204.

Step 2: If the results of the initial two or three test borings are favorable, then we would suggest that four additional test borings be drilled at locations approximately 300 to 500 feet east and west of stations 134/135 and 204. These test borings are suggested to help verify the local extent, thickness, and texture of the sand and gravel aquifer expected to be present.

The decision to proceed from Step 1 to Step 2 can be a field decision made by you, your drilling contractor, and your consulting engineer. We can be consulted by telephone if desired. For each test hole:

An accurate driller's log of the materials penetrated is needed.

Samples of all sand and gravel materials should be collected every 5 feet for future examination and possible sieving to determine the grain size distribution of the aquifer materials.

A Division of the
Illinois Department of Energy and Natural Resources

Downhole logging of one or more test borings by the State Geological Survey can be conducted as described in the December 2, 1994, EERS Report if the necessary arrangements can be made. Contact Phil Reed directly for this work.

After the information collected from Step 1 and Step 2 is reviewed by the Geological and Water Surveys, recommendations for the next step can be confirmed. Assuming that results are favorable, then

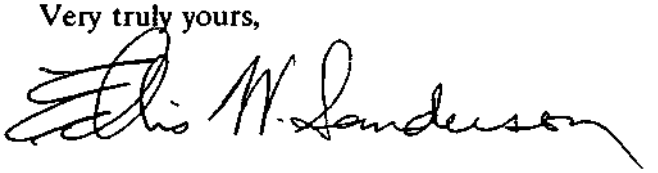
Step 3A: Drill one ground-water level observation well and a test pumping well (TW 1-95; should be capable of 200 to 400 gpm) at locations suggested by information from the test borings.

Step 3B: Conduct a step test and a 24-hour aquifer test on TW 1-95. If these results are favorable, construct at least 2 or more additional observation wells at appropriate locations and conduct a 7-day aquifer test to obtain sufficient data to estimate aquifer yield to a well field. Evaluate results of aquifer tests. (The data collection and evaluation can be accomplished by the Water Survey if appropriate contractual arrangements are made.)

Step 4: Study results of aquifer evaluation. Decide on future course of action.

These steps are suggested. We will be glad to meet with you and your consulting engineer to further discuss the evaluation of the suggested site if you desire. Please keep us informed if the test boring program is planned.

Very truly yours,



Ellis W. Sanderson, P.E.
Senior Engineer
Office of Ground-Water Resources
Evaluation and Management
Phone: (217) 333-0235

c: P. Reed, ISGS
IEPA (2)

ILLINOIS DEPARTMENT OF NATURAL RESOURCES

Illinois State Water Survey

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SWS

January 17, 1995

Mr. Delbert Mundt, President
E J Water Corporation
P.O. Box 8
Dieterich, IL 61424

Dear Mr. Mundt:

This letter is in response to our conversation during the meeting at our offices on September 26, 1994, our telephone conversation in mid-December, 1994, and our field visit to the E J Water Corporation well field on January 13, 1995, regarding a long-term monitoring program for the present well field. The well field is located in Section 34, T.8 N., R.9 E., Jasper County.

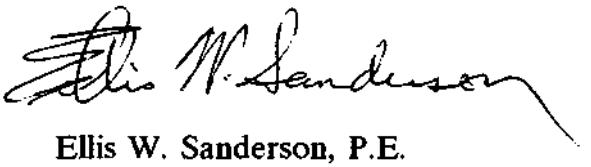
The objective of a long-term monitoring program at the present well field is to be able to determine whether future pumpage increases will cause overpumping of the sand and gravel aquifer system with subsequent ground-water level decline; The long-term monitoring program must consist of two essential elements: well field pumpage data and ground-water level data. If ground-water levels are determined by periodic steel tape or dropline measurements, the total pumpage data should be available for comparable periods, or at least on a monthly basis. In addition, some basis for measuring or estimating the proportion of pumpage from each production well would be helpful. Total operating hours for each well may be satisfactory.

Monitoring of ground-water levels in the sand and gravel aquifer will require the construction of at least one dedicated observation well. If only one well can be constructed and monitored we suggest that an acceptable location may be approximately equidistant between Well 1 and Well 3 (about 300 to 350 feet from each) and about 150 to 200 feet south of Well 2. According to a location map dated February 22, 1994, (Sheet 4, Project No. 94601) furnished by Milano and Grunloh Engineers, Inc., the suggested site would be in or near a wooded area at the south edge of small cropped area owned by a Don Lambird (see attached copy of a portion of the location map). If a second dedicated observation well can be constructed and access is available, we suggest a location northeast of Well 2 and northwest of Well 3 between the wells and near the Embarras River.

Ground-water levels in the observation well(s) may be either measured manually on a regular schedule or equipped with a mechanical or electronic water level recorder. Manual measurements should be done on a schedule compatible with the method of totaling ground-water pumpage (e.g. weekly, monthly, or the present schedule of every 10 days on the 5th, 15th, and 25th of each month). If you desire to use a mechanical or electronic recorder, you may wish to select that equipment before constructing the monitoring well to assure that the diameter of the upper part of the well(s) casing is appropriate for the selected equipment. The observation well(s) should fully penetrate the sand and gravel aquifer and be equipped with a well screen about 15 to 20 feet long. Alternating short sections of well screen and blank well casing in the bottom 15 to 20 feet of the aquifer also will be acceptable.

Please contact us if you have any questions.

Very truly yours,



Ellis W. Sanderson, P.E.
Senior Engineer
Office of Ground-Water Resources
Evaluation and Management
Phone: (217) 333-0235

Enclosure as stated.

c: IEPA (2)

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SWS

May 29, 1996

Mr. David Klitzing
General Manager
E J Water Corporation
P.O. Box 8
Dieterich, IL 61424

Dear Mr. Klitzing:

This is to confirm our telephone conversation on May 29, 1996, regarding the next step for your corporation to take towards the goal of developing a well field in the vicinity of Section 10, T.7 N., R.9 E., Jasper County.

The additional test borings (TB's. 12 - 16) made on May 23, 1996, continue to confirm the presence of the sand and gravel aquifer associated with the bottomlands of the Embarras River valley. Since time and field conditions on May 23rd prevented test borings at all suggested locations, whether you would like to drill additional test borings at other locations before proceeding to contract for a Test Well and associated observation wells is a decision to be made at this time.

If you decide to drill additional test borings, Tim Young, State Geological Survey, and I suggest the following locations be considered: two test borings in EERS alignment 1 (northernmost), two test borings in EERS alignment 5 (southernmost), and two or more test borings in the vicinity of Test Borings 7 and 16 to determine whether this area might be better than the area near TB 4. TB 7 and 16 are about 1700 and 2000 or so feet east of TB 4. Because they are farther from the bluff and the bedrock surface may be a couple of feet lower in elevation, this area might have the possibility for increased yield depending on the hydraulic conductivity of the sand and gravel. Mr. Young indicates that he is willing to mark test boring sites in the field if you desire.

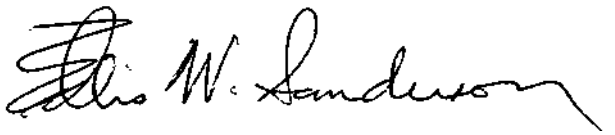
Proceeding with the aquifer evaluation for a well field in the vicinity of TB 4 is the other option at this time. If you decide to go ahead with the aquifer evaluation without the additional borings described above, then I suggest that you select a spot

for the Test Well and contract to drill three 2-inch observation wells (equipped with 10-15 feet of well screen) at distances of about 75, 200, and 500 feet north and/or south of the selected test well spot. Provided the logs of these observation well holes reveal no major surprises in the thickness and texture of the sand and gravel aquifer, then proceed to drill a test hole at the selected Test Well spot for the purpose of collecting formation samples for subsequent grain size analysis (sieving) and design of the Test Well (gravel pack, screen length and slot size). When you have the Test Well design suggestions, then you may contract for its construction, development, and the conduct of the aquifer test.

The test boring information collected to date indicates that the chances are good for developing a production well in the vicinity of TB 4. However, we can only speculate about the potential yield of this area until the aquifer test is conducted with the Test Well and observation wells and the collected data analyzed.

Please contact me if you have any questions.

Very truly yours,



Ellis W. Sanderson, P.E.
Senior Engineer
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c: Tim Young, SGS

ILLINOIS DEPARTMENT OF NATURAL RESOURCES

Illinois State Water Survey

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SWS

November 18, 1996

Mr. David Klitzing
General Manager
E J Water Corporation
P.O. Box 8
Dieterich, IL 61424

Dear Mr. Klitzing:

We have completed our analysis of the data collected during the aquifer test on October 17-21, 1996, on E J Water Corporation, Test/Production Well (PW) 11. This aquifer test was conducted with the capable assistance of Jim and Danny Speth, Speth Plumbing, Inc., and Trustees and staff of the E J Water Corporation. PW 11 is about 51 feet deep and finished in a sand and gravel aquifer associated with the bottomlands of the Embarras River. It is located approximately 1370 ft South and 2700 ft East of the NW corner, Section 10, T.7 N., R.2 E., Jasper County.

Analysis of the data collected from PW 11, Observation Wells (OW) 1, 2, and Test Boring (TB) 4 indicated the transmissivity of the sand and gravel aquifer at the time of the test averaged about 39,900 gpd/ft (hydraulic conductivity of about 1140 gpd/ft^2). Data from OW 3 suggested a somewhat greater transmissivity of about 51,500 gpd/ft (hydraulic conductivity of about 1560 gpd/ft^2). Data from all the observation wells (except TB 4) provided reasonably consistent values for the storage coefficient, averaging about 1.5×10^{-3}. Thus, the aquifer appeared to remain under artesian conditions during the test, perhaps indicative of "layering" of the sand and gravel formations with thin layers of finer-grained materials. The storage coefficient under long-term pumping conditions is expected to be greater, enhancing the yield capability of the proposed well field. Our experience under similar aquifer conditions has shown that an assumed value of 0.1 for the storage coefficient is reasonable and allows representative well yields to be estimated.

None of the observation well data indicated the presence of an inferred aquifer boundary west of the site (river bluff) during the test period. Although the test data did not exhibit the effects of the barrier boundary, regional data make its presence known. Since the aquifer test was conducted during a time period when the barometric pressure was relatively stable and Embarras River stages were almost constant, no adjustments were made to the collected data to account for these potential influences on ground-water levels.

The yield of a shallow sand and gravel aquifer also must take into account effects on ground-water levels by extended drought conditions. In this case, there are no data available to indicate how much natural decline in ground-water levels might occur during extended drought periods. Because the aquifer test was conducted during a relatively dry

period in the fall, it was assumed that ground-water levels during a future long-term drought might be only about 3 feet lower than at the time of the aquifer test. These lowered ground-water levels would have the effect of reducing the saturated thickness of the sand and gravel aquifer and reducing the transmissivity of the aquifer. The driller's logs of the test well and the observation wells and measured depths to water showed the average thickness of the aquifer to be about 33 feet. If this thickness were reduced 3 feet to allow for drought conditions, then a transmissivity of about 34,200 gpd/ft would result.

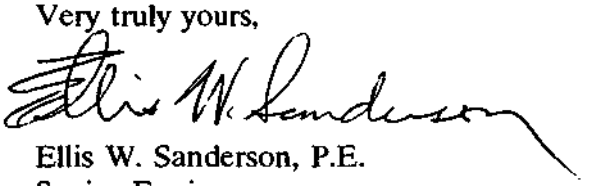
With this information, a theoretical idealized model of the aquifer conditions in the vicinity of PW 11 was hypothesized. The aquifer model was a semi-infinite aquifer bounded by one barrier boundary trending north-south about 1500 feet west of the well. The semi-artesian storage coefficient of 1.5×10^{-3} was expected to approach a water-table value of about 0.1 under long-term pumping conditions. Using this expected value in the evaluation of well field yield appeared reasonable and allowed development of the desired yield of a well field.

Thus the model aquifer consisted of the following elements: 1) a transmissivity of about 34,200 gpd/ft, 2) a storage coefficient of 0.1, and 3) a barrier boundary about 1500 feet west of the well field and parallel to the planned line of production wells. Allowance was made for dewatering up to 50 percent of the saturated thickness of the aquifer at the production well sites by adjusting drawdowns for the concomitant decrease in transmissivity.

Based on the assumptions and conditions described above, the idealized model aquifer, and resulting calculations of drawdown and interference effects, it appears that a well field yield of up to about 300 gpm (0.43 mgd) is feasible from three production wells (100-gpm each) spaced about 250 feet apart. Whether a withdrawal rate of 300 gpm can be sustained on a continuous basis during extended drought conditions is not entirely evident. It is expected that the desired 200-gpm supply can be sustained during drought conditions. Each production well ought to be equipped with about 10-12 feet of well screen and the well pump intake positioned about 15 feet from the bottom of the well.

Please contact us if you have any questions regarding this matter.

Very truly yours,



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cc: Mr. Pat Milano, Milano and Grunloh
Mr. Jim Speth, Speth Plumbing, Inc.
Mr. Gordon Dill, RDS
IEPA (2)

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SWS

September 5, 1997

Mr. David Klitzing
General Manager
E J Water Corporation
P.O. Box 8
Dieterich, IL 61424

Dear Mr. Klitzing:

We have completed our analysis of the data collected during the 24-hour aquifer test on August 5-6, 1997, on E J Water Corporation, Production Well (PW) 12. This aquifer test was conducted with the capable assistance of Mr. Jim Speth, Speth Plumbing, Inc. PW 12 is about 48 feet deep and finished in a sand and gravel aquifer associated with the bottomlands of the Embarras River. It is located approximately 890 ft South and 2745 ft East of the NW corner, Section 10, T.7 N., R.9 E., Jasper County.

Analysis of the data collected from PW 12, Observation Wells (OW) 1, 2, 3, 4, and PW 11 (as an OW) indicated the transmissivity of the sand and gravel aquifer at the time of the test averaged about 42,250 gpd/ft (hydraulic conductivity of about 1170 gpd/ft^2), a value slightly higher than found during the aquifer test conducted with PW 11 in October, 1996. Data from all the observation wells provided values for the storage coefficient that were in the artesian range, averaging about 1.1×10^{-3}. Thus, the aquifer appeared to remain under artesian conditions during the test, perhaps indicative of "layering" of the sand and gravel formations with thin layers of finer-grained materials as suspected during the previous aquifer test with PW 11. The storage coefficient under long-term pumping conditions is expected to be greater, enhancing the yield capability of the proposed well field. Our experience under similar aquifer conditions has shown that an assumed value of 0.1 for the storage coefficient is reasonable and allows representative well yields to be estimated.

As with the aquifer test in October 1996 using PW 11, none of the observation well data indicated the presence of an inferred aquifer boundary west of the site (river bottomland bluff) during the test period. Although the test data did not exhibit the effects of the barrier boundary, regional data make its presence known. The aquifer test also was conducted during a time period when the barometric pressure was relatively stable and the Embarras River stages were almost constant, so no adjustments were made to the collected data to account for these potential influences on ground-water levels.

The yield of a shallow sand and gravel aquifer also must take into account effects on ground-water levels by extended drought conditions. Ground-water levels during this aquifer test were found to be nearly 3 feet higher than in October 1996 when the PW 11 aquifer test was conducted. To make the analysis of this aquifer test data comparable, it was assumed that ground-water levels during a future long-term drought might be about 6 feet lower than at the time of the aquifer test. These lowered ground-water levels would have the effect of reducing the saturated thickness of the sand and gravel aquifer and reducing the transmissivity of the aquifer. The driller's logs of the test well and the observation wells and measured depths to water showed the average thickness of the aquifer to be about 36.1 feet. With the lower ground-water levels expected during drought conditions, a reduction in average thickness of the aquifer to about 34.3 feet results. This reduced aquifer thickness results in a transmissivity of about 40,100 gpd/ft. (This is about 17 percent greater than used in the well field design in October 1996 due to a slight modification in the analysis approach and the correction of a previous error).

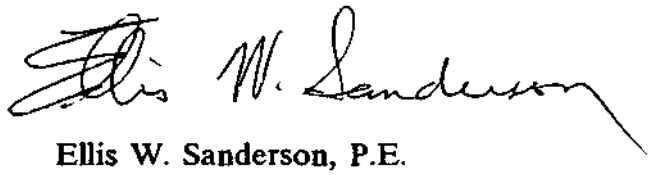
With this information, a theoretical idealized model of the aquifer conditions in the vicinity of PW 12 was hypothesized. The aquifer model was a semi-infinite aquifer bounded by one barrier boundary trending north-south about 1500 feet west of the well. The artesian storage coefficient was expected to approach a water-table value of about 0.1 under long-term pumping conditions. Using this expected value in the evaluation of well field yield and the yield from Well 12 operating alone appeared reasonable. Thus the model aquifer consisted of the following elements: 1) a transmissivity of about 40,100 gpd/ft during drought conditions, 2) an assumed storage coefficient of 0.1, and 3) a barrier boundary about 1500 feet west of the well field and parallel to the planned line of production wells. Allowance was made for dewatering up to 50 percent of the saturated thickness of the aquifer at the production well sites by adjusting drawdowns for the concomitant decrease in transmissivity.

Based on the assumptions and conditions described above, the idealized model aquifer, and resulting calculations of drawdown and interference effects, the well field design suggested in our letter dated November 18, 1996, is confirmed. A well field yield of about 300 gpm (0.43 mgd) is feasible from three production wells (100-gpm each) spaced about 250 feet apart. Using the higher average value of transmissivity derived from the Well 12 aquifer test suggests that it may be possible to expand the well field to a yield of 400 gpm (0.57 mgd) by adding a 4th production well to the well field south of Well 11. Whether a withdrawal rate of 400 gpm can be sustained on a continuous basis during extended drought conditions is not entirely evident. It is now expected that the 300-gpm supply can be sustained during drought conditions. Each production well ought to be equipped with about 10-12 feet of well screen and the well pump intake positioned about 15 feet from the bottom of the well.

We understand that at this time, it is preferred to use only one production well to obtain a supply of 200 gpm to match the newly expanded treatment plant capacity of 200 gpm. The analysis of the data suggest that it should be possible to operate Well 12 at a rate of 200 gpm with the pump intake set at a depth of about 36 feet as long as it is operated alone during extended drought periods. To increase the yield of the well field to more than 200 gpm during drought conditions, it will be necessary to operate 3 or 4 production wells, each pumping at a rate of about 100 gpm.

Please contact us if you have any questions regarding this matter.

Very truly yours,



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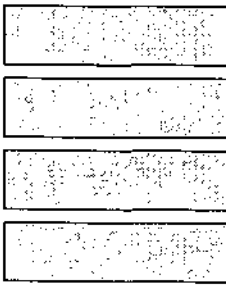
IEPA (2)
Ms. Becky Bennett, ISWS

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